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J. V. W. REYNDERS,
President 1910.

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THE PRESIDENT'S ANNUAL ADDRESS.

By J. V. W. Reynders.

The task imposed upon the retiring president of making an address has been perceptibly lightened for some time to come by the admirable address of my predecessor, Mr. F. Herbert Snow, who covered in such an able and thorough manner a subject so important to us as engineers, and one that ought at all times to be kept before us,—a perspective of the historic development of engineering, forming as it does the basis and the justification of our professional status. It is my purpose to-night to no more than briefly refer to two phases of modern development, concerning the economic solution of which engineers will be vitally interested:

When we consider engineering in its broad aspect as representing the efforts of mankind to transform this world of ours, for good or evil, from a tree-covered planet in which no forces were evident except those of the elements, and where the efforts of man were confined to a struggle of uncertain outcome against the beasts of the forest, to a world of civilization, in which man has conquered every other living thing, in which he has harnessed the forces of nature to his own uses, in which inter-communication by rail, by water and by air, by telegraph, by telephone and by wireless has placed him in daily and intimate touch with all the remote regions of the earth,—when we contemplate the tremendous transformation which has taken place since the beginning of man's advent; it becomes evident that the engineer, whether recognized as such or by some other name, has been identified with the one human force, the exercise of which has gone on continuously and consistently, irrespective of the rise and fall of nations. No essential arts have ever been lost. Each new civilization has adopted and profited by the economic achievements of its predecessors.

If there is any one distinguishing characteristic which differentiates our present age from all preceding ones, it is the scale on which its operations are conducted: We have ceased to think in terms applicable to localities or to nations, but our statistics embrace continents. So gigantic has this scale become that we have reached a stage of development where we are able to approximate the world's remaining supplies of raw materials; we have established fairly well the law of increasing consumption, and from these two premises we are able to conclude that the world's progress will be arrested within a measurable period, not by the enterprise of man, but for lack of raw materials. It will not be 50 years, as some alarmists have claimed, but even should the anticipated contingency not arise for 400 years, it requires us to look into the future no farther than would have been necessary had the contemporaries of Columbus endeavored to forecast in their minds the state of the world in this year of 1911.

As far as the engineer is concerned, this reflection points to the increasing importance of economy in the use of natural resources not in the sense that enterprise should be checked, which is impossible, save from inherent causes, but rather that there should be no needless waste of the materials entering into manufacture and construction. This, in the higher sense, will be one of the great moral responsibilities of our profession in the future.

The other overshadowing problem which touches the engineer closely has to do with the adjustment of the wage-earning classes to the modern scale of undertakings.

The conflict between socialistic and individualistic points of view never has been, and in my opinion never will be, anything more than a struggle between theory and practice, in which the practical point of view will prevail. Hundreds of communistic experiments have been tried, some broad and far-reaching in scope, but none has succeeded because no plan has yet been devised that did not pre-suppose a radical change in human nature.

Ultimately we will learn to appreciate that from an economic point of view the world as a whole cannot pay out more in *creature comforts* than the aggregate of *creature comforts* which it produces. In other words, there can be no average daily distribution in excess of wealth produced, on the average, each day. We cannot have a shortened work day or reduced output without being confronted by the lessened purchasing power of that depreciated day's work.

The so-called swollen fortunes, while deplorable, do not change the fundamental correctness of this statement. Granted that there are a hundred fortunes in America, averaging a hundred millions each, which is probably not so, a general division would give to each of us a hundred dollars, hardly enough to talk about.

The main economic essential is that we as a nation must produce, collectively, at as high an average rate of individual efficiency as our most favored competitor, or else we will lose in the race.

To engineers, coming as they do in close touch with manufacturing operations, these facts are fundamental and self-evident. To many writers on public questions, however, the elements of prosperity and of individual happiness are not quite so apparent.

I regret that the demands on my time have made it impossible to extend my observations to the extent that is appropriate to the occasion: I desire to say in closing, however, that I am convinced now, as always, of the growing future of the Engineers' Society of Pennsylvania, and I bespeak for my successor, Mr. David E. Tracy, your enthusiastic and loyal support.

THE FUNCTIONS AND THE PROBLEMS OF THE ILLUMINATING ENGINEER

BY DR. CLAYTON H. SHARP.*

Read before the Convention of Engineers in Harrisburg, June 2, 1910.

In point of capital invested and of financial transaction involved, the production of artificial light ranks as one of the greatest industries of the country. The greater part of the gas, oil and electrical energy are used in the production of light. The manufacture of lamps, mantles, chimneys, shades and reflectors involves operations on a large scale. The scientific study of illuminants has received considerable attention for many years. Methods of determining candle-power and efficiency have been worked out with great care, and apparatus for carrying out these methods are well known. Not so much attention has been devoted in the past, however, to the scientific study of the proper utilization of the light produced. It is only within recent years that engineers in this country have come to recognize the importance of this subject. In both the gas and electric industries it may be said that the chief attention has been given to the production of the raw material for the production of light, *i. e.*, the production of gas or electric energy. The best and most economical methods of production or generation have been carefully studied and have secured by far, the largest amount of attention. Apparatus to realize a saving of a small percentage in the generating cost has been looked upon as being of the very greatest value, overlooking the fact that the field for improvement of the lamp is far greater than that of the generator.

Too often the engineers connected with lighting companies have given comparatively little attention to the proper utilization of the gas and electricity which they produce. The gas man has taken the stand that he is selling gas, not light, and that it is a matter of indifference to him how the gas is utilized by the consumer. He has taken little trouble to find out whether the consumer has used good burners or poor ones, open flame or mantle burners. To him the prime consideration has been the sale of the gas and not the satisfaction derived by the consumer from the gas so sold. The same may be said of the electrical engineer. The inefficient use of electric current by the consumer, by the employment of poor lamps, seemed to be a thing which concerned him only in a secondary degree. These remarks, be it understood, do not apply to the most enlightened and progressive gas and electrical engineers. Particularly in recent years, the lighting companies have made it their business to see that their consumers get not only gas or electricity, but that they get light, and as much light as practicable for the money which they expend, and this attitude is rapidly becoming general.

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* Test Officer of the Electrical Testing Laboratories of New York.

The increased attention given by engineers to the apparatus for transforming the gas or electricity into light has resulted in new illuminants of much higher efficiency, producing economies in light production many times greater than any which could possibly be made by improvements in the already efficient generating processes. The lighting companies have taken an active interest in introducting improved illuminants into the installations of their consumers, resulting in greater satisfaction to all parties concerned. More recently the engineers have gone a step further by giving attention not only to the light which is produced but to the proper utilization of this light in the production of illumination. Whether it is recognized or not, what the consumer really wants is illumination rather than light, so that this evolution marks a step in advance in the attention given to the ultimate product of the lighting company.

The recognition not only by engineers but by the public generally of the fact that illumination, as distinguished from light, is alone what is desired and utilized, and also that the production of proper illumination, involves a great many important questions which need not be considered in the production of light has resulted in the rise of illuminating engineering as a distinct branch of engineering science. An expression of the importance which is attributed to this branch of engineering is given in the foundation of the Illuminating Engineering Society,—a society which organized in 1906, has now a membership of over 1,000, and in the more recent foundation of a similar society in London.

Illuminating Engineering, being the latest engineering specialty to demand separate recognition, it is well to consider very briefly the importance of this branch and the broad features of the problems with which the illuminating engineer has to deal.

Reference has been made to the importance of the industry of purveying artificial light. When all has been said that can be said along these lines, but a small part of the story has been told. The social and economic importance of artificial illumination is enormous. Artificial illumination ranks after fuel, clothing and shelter, as one of the greatest necessities of life. The modern world would not be what it is if the modern artificial illuminants did not exist. It is only by the aid of the modern illuminants that the reign of law and order is maintained in our city streets at night and that the present output of our industrial establishments is maintained. And the constant demand of civilized man is voiced in Goethe's cry for "more light".

The increasing intricacy of manufacturing processes demands better and better illumination for their prosecution. The dark and dingy workshop is a thing of the past age. The modern factory is a building of glass walls in recognition of the industrial importance of an abundant supply of that most powerful illuminant, daylight. To maintain the rate of working during the hours of external darkness, the artificial illumination must be commensurate with that enjoyed during daylight hours. There is no more short-sighted economy than that which curtails the illumination which the workman requires for his maximum accuracy and speed of operation. A trifling sum saved in the cost of light may result in diminished output and defective product. All the problems arising in this broad and most important field fall within the domain of the illuminating engineer.

The illuminating engineer, while greatly concerned with the methods of generation and distribution of gas and electricity, and while vitally interested in the lamps which serve for the production of the light, has a field which extends far beyond the bounds of these two branches of engineering science. He must be able to deal with the production of the proper illumination under given local conditions, and also must be able to measure the illumination so produced. He must take a given space which is to be utilized for certain purposes, and lay out an illumination installation such as will satisfy the requirements set by the purposes for which this space is to be utilized. Let us examine what some of these requirements are.

In the first place the illumination must reach a certain value. In many interiors it is required that the illumination should be as uniform as possible throughout, or over the entire floor space. In other interiors the proper illumination of the walls is the matter most to be considered. In some cases uniform illumination is not required. Certain regions must be properly illuminated while the illumination of the remainder of the space is a matter of secondary importance. A room requiring uniformly distributed illumination is typified by a large auditorium. An example of an installation where wall illumination is required is a library or a store where goods on shelves have to be displayed. Localized illumination may be required in a large room used as office space where numerous desks are present, or by a factory room with numerous machines.

The degree of illumination required in various cases is also a matter which is subject to modification, according to the conditions which obtain. For instance, if, during a certain part of the day, artificial illumination is combined with natural illumination or in a measure competes with natural illumination by daylight, the artificial illumination will, in general, require to be more intense than if no such comparison with daylight need be made. The degree of illumination is also dependent upon the character of the work which must be done. For fine work or for work on dark colored surfaces, or for work on moving objects, a higher illumination is required than when the opposite conditions obtain. Moreover, the speed with which work is accomplished depends somewhat on the illumination of the object which is being watched. It has been demonstrated, that a person can read faster with a moderately strong illumination than with a dim one. The same condition must prevail in the case of manufacturing processes. It is necessary, therefore, for the illuminating engineer in designing an installation to draw from the fund of his experience, in order to decide what degree of illumination is required in each specific case. This purely engineering consideration comes usually more or less into conflict with the architectual or aesthetic requirements of the case, and not infrequently must be subordinated to them.

In planning an illumination installation the prime object from a purely engineering point of view to be obtained is, in a generality of cases, high illumination efficiency. It may be said that in no case should the latter effect be lost sight of. It is as important to give a pleasing effect to the illumination of the interior of a factory as it is to have a good architectual design to the exterior. The illuminating engineer must harmonize as well as possible the scientific with the aesthetic requirements and must arrange between them such intelligent compromises as the conditions call for. Thus, illuminating engineering has a well marked aesthetic side, as does all other good engineering.

Efficiency being a prime requisite we may consider some of the elements of the illuminant to be employed. This selection can not be made on the basis of efficiency alone. Various other considerations have to be taken account of than merely the candle-hours per dollar, though of course, this figure is one of the most important ones.

The question of the choice of gas or electricity is very often answered by reference to such considerations as availability of supply, fire hazard, ventilation, convenience, appearance, cost of installation, cost of maintenance. The size of the lighting units available is also a question which may be decisive, since the proper distribution of the illumination may depend upon whether units of small candle-power are to be had or whether the illuminant under consideration is available in large candle-power units alone. In a large room with a comparatively low ceiling uniform illumination can be obtained only by the use of a large number of individual sources of light which, therefore, must each be of small candle-power. Where considerable height is available more powerful illuminants may be used, but they must then be raised a greater height above the floor. The illuminant having been chosen the proper auxiliaries in the form of shades, reflectors, etc., must be found. In a great many cases the lamp alone would send a considerable portion of its light in such directions as to make it unavailable for the purposes of the illumination required. By the use of suitable reflectors, such waste light may be re-directed, so that it participates directly in the production of useful illumination. Reflectors may be required which will illuminate a small area to quite a high intensity, or a larger area at lower intensity. The efficiency of the installation is largely dependent upon the proper selection of such auxiliaries.

In the selection of the proper type of reflector, the engineer is guided by diagrams showing in polar co-ordination the apparent candle-power of the source of light with reflector. Reflectors are constructed of glass and of opaque substances. Clear or translucent glass reflectors permit the passage of a certain amount of light which produces a feeble illumination of the ceiling—very often a desirable result. Opaque reflectors require auxiliary lighting to produce this effect, but they possess in their own proper field advantages which do not belong to the glass reflector.

Globes have in general the effect of diffusing the light. This effect is most important, and bears directly upon what may be called the physiological efficiency. It is a well-known fact that the sensibility of the eye is greatly diminished by the presence of strong lights in the field of vision. The magnitude of this effect depends upon the specific intensity or the candle-power per square inch of the intruding source of light. Now, the specific intensity of many sources of light, particularly electric arcs and clear bulb incandescent lamps, is very high, hence if unshielded sources of this character lie within the field of vision and not too far from the eye they produce an effect of glare which diminishes the sensitiveness of the eye as far as the discernment of objects is concerned. A good deal of this effect, though not all of it, is to be attributed to the automatic action of the iris of the eye, which closes in the presence of strong lights and hence diminishes the amount of light which is received from all objects within the field of vision. By the use of diffusing media such as are commonly employed in glass globes, the specific intensity of the source of light, and consequently the glare, is greatly diminished. From this it follows in many cases, that while the diffusing globe actually diminishes the illumination, yet the physiological efficiency of the installation is notably increased. Glare is to be avoided for another reason as well, namely, to prevent actual injurious effects upon the eye. The minute area on the retina of the eye upon which the filament of an incandescent lamp is focused is subjected to a very intense luminous excitation which may very well be accompanied with deleterious results. In the selection of diffusing media care must be taken to get the maximum of diffusion with the minimum of absorption of the light. It is here that the judgment of the illuminating engineer, guided by the results of laboratory tests is very important in determining the results obtained in the illumination installation.

In order to secure the proper distribution of the illumination in an installation, and also to minimize the effects of glare, the proper location of the lamps must be determined upon. For the production of the general illumination the location of the lamps will, in general, be at a considerable height from the floor, whereby a uniform illumination is secured, and the lamps themselves are removed well above the ordinary field of vision. Where a localized illumination is chiefly needed, as in desk and machine work, the general illumination can by no means be neglected. It has been shown by some very striking experiments made by Mr. L. B.

Marks, that a lower localized illumination, combined with a diffused general illumination results in much better conditions for machine work than does a localized illumination alone. The result of a localized illumination, using—say, lamps with green shades immediately over the work, are likely to be bad unless the general illumination of the room accompanies it, for the eye, when looking up from the work becomes very sensitive through pupilar dilation and then is momentarily shocked by an excessive amount of light when looking back at the work, the iris of the eye not acting instantaneously.

The effectiveness of the general illumination which is to be combined with the localized illumination is determined, to a considerable degree, by the color and cleanness of the walls and ceiling of the room. Clean white walls and ceilings are most admirable reflectors and diffusers of light. A very considerable general illumination can be produced in a room with white walls and ceiling with a relatively insignificant amount of light, so that the combination, under these circumstances, of general and local illumination is economically carried out. The influence of the character of the walls and ceilings on the illumination is an important and somewhat uncertain factor with which the illuminating engineer has to deal in making his calculations of the amount of light required. With white walls and ceiling the amount of light required to produce a given illumination will, in many cases, be one-half or one-quarter of what would be required if the walls and ceiling were black. Intermediate tints on the walls have intermediate effects. The coefficients of reflection of various characters of wall covering have been determined experimentally, but unfortunately such coefficients of reflection can not be used directly in illumination computations, because the influence of wall and ceiling reflection on illumination on a table plane is dependent very largely upon the size and shape of the room, and upon the position of the source of light in the same, consequently this is a matter which must be left largely to the judgment of the illuminating engineer.

Attempts have been made repeatedly to secure perfect diffusion of the light, uniform illumination, absence of shadows and absence of glare, by what is known as the indirect system of illumination. In this system, sources of light which are concealed from people on the floor, throw their light on the ceiling, or on the cove of the room, which for this purpose must possess a good reflecting surface. The light reflected by the ceiling then produces the illumination on the floor. This plan is very effective in giving a uniform illumination free from shadows, but it suffers from certain disadvantages which for the most part are sufficient to condemn it. In the first place, it is highly inefficient. This inefficiency is due not only to the absorption of light by the ceiling, but also to the entire lack of tendency to direct the rays of light so as to make them most efficient. A large part of the light reflected from the ceiling reaches the ceiling in another part of the room, or the walls, and is gradually absorbed without ever having participated in the useful illumination of the room. Hence, a much larger quantity of light is required to produce a given illumination in this way. Furthermore, the ceiling being the brightest illuminated object in view and necessarily brighter than a book being read or a piece of work, it sets up to the eye a standard of illumination which causes the eye to demand more light than would be the case if the illumination came from point sources. Although the specific intensity of the ceiling in any installation of this kind is not high, yet the bright expanse of illuminated surface gives an effect of glare to the eye such that it is not easy to work with an illumination of this character. In many cases, the absence of shadows is in itself objectionable since things come into relief through the effect of light and shade, and to do away with light and shade makes it less easy to distinguish the form of objects. The effect of the illumination is unnatural and unpleasant to most eyes. The eye seems to expect and to demand point sources, and in most cases, illumination is more economically and more satisfactorily carried out by the ordinary system.

The chief factors which have to be taken into consideration by the engineer in planning the illumination of an interior have been outlined. The local conditions are so varied, and the practical requirements, as given, and the factors stated are so involved that there is evidently a chance for the exercise of the highest skill in this class of work.

Another very important field with which the illuminating engineer has to deal is that of exterior illumination. The illumination of public squares, streets, and highways, involves certain other considerations and limitations which are not present in the case of interiors. In the first place, the extent of the street requiring illumination is practically limitless and the demand for more light is unceasing. The standard of street illumination is continually rising. Residential streets are far better lighted than they were in the days of open gas flame, but the illumination is still insufficient. Country highways which a few years ago were in Stygian darkness, are now outlined by streets lights, but with the increasing density and speed of highway traffic, the need for a more effective highway illumination is becoming more and more imperative. In the face of an undoubted demand for higher degrees of illumination and for continuous extensions of lighting systems on streets now unlighted, the most important question which arises is that of economy. An economical street lighting system can be realized in any particular case by the selection of such illuminants as shall be most economical, by the proper location of these illuminants, and by the most effective utilization of the light which is developed by them. It must not be supposed, however, that economy is the only consideration in street lighting. The esthetic effect, decorative effect, etc., have manifestly their place in street illumination, as they do in interior illumination. Proper diffusion of the light is required out-of-doors as indoors, and is much harder to attain. Glare from street lights is also undesirable, and this is even more difficult to avoid.

In the illumination of large open squares in cities, the illuminating engineer has at his disposal a choice of powerful and efficient modern illuminants well fitted for the purpose. It is the simplest problem in exterior illumination. For instance, powerful sources of light such as flaming arc lights may be used for the purpose, and there being a considerable area to illuminate, with no obstructions, the lamps may be placed so high that the glare from them is not excessive. Powerful mantle burners may be used in the same way. By taking suitable reflectors the illumination installation is efficient and the result eminently satisfactory. A case in which artistic effect as well as efficiency, is absolutely required is that of a public park. Here the best illumination is one from well diffused sources of light such as will soften the shadows and will produce no objectionable glare. In some recent installations, tungsten lamps in large diffusing globes have been employed for this purpose, and also for the illumination of streets where an artistic effect is particularly desired, and the outcome of these attempts has been most pleasing.

In the ordinary illumination of streets and highways, a somewhat different problem of distribution of the light for the production of an effective illumination is presented than that which has to be considered in the case of the illumination of a room. for the illumination of interiors, it is desirable that a certain flux of light reach the ceiling. The ceiling itself must be illuminated, and it sends back a proportion of the light which impinges upon it to participate in the useful illumination of the room. In the case of street illumination, all light leaving the fixture above the hortizontal plane is absolutely wasted, in fact it often goes where it is not wanted, therefore, a reflector used in street lighting should be so arranged that it will direct as nearly as possible all the light in directions below the horizontal plane. Furthermore, in interior illumination, the distribution of light about the vertical axis of the lamp with its reflector, may usually without detriment to efficiency, be symmetrical. In the illumination of streets, the case is quite different. The crosswise dimension of a street may be taken as of negligible importance as compared with the lengthwise dimension. Therefore, if the distribution of light be symmetrical, an undue proportion of the light is directed toward the sides of the street. The distribution must be unsymmetrical, a far greater proportion of light being directed lengthwise of the street than crosswise of the street.

The requirement of street illumination is that the roadway and objects in the same shall be illuminated to a degree which shall at every point exceed a certain minimum value. What results from the ordinary arrangement of lamp alone or lamp with symmetrical reflector is that, in the vicinity of the lamp, the street may be well illuminated, but this illumination falls off rapidly with the distance, so that at a point midway between lamps it has a relatively very low value. At the same time, each lamp distributes crosswise of the street as much light as lengthwise, and only a small proportion of this light is effective in lighting the street itself, the major part being wasted on the roadside. Thus the ordinary system of street illumination is very inefficient from two causes, first in that only a small percentage of the total luminous flux is incident on the surface to be illuminated, and second in that the distribution of the flux so incident is such that the illumination in the immediate vicinity of the lamps is unduly high, while midway between lamps, the minimum illumination, which is by far the most important factor to be considered is far too low.

I have recently had the honor to describe before the Illuminating Engineering Society a form of reflector for street lighting which is intended to give a more efficient illumination of the streets with a given amount of light from the lamp than is ordinarily obtained. The idea underlying the reflector is that it shall collect the light ordinarily wasted in the upper hemisphere and toward the sides of the street, and redirect that light so that it falls on those parts of the street where it is most needed, namely, in the region midway between the lamps.

This result should be accomplished without interfering with the natural illumination on the street surface from the lamp directly, so that in case the device became inoperative or operated badly, as by the accumulation of dirt, the illumination would at least not be any worse than if the device were absent entirely.

It is clear that stray light could be collected and redirected so as to illuminate the regions midway between the lamps by the use of a parabolic mirror with the lamp at the focus. But this arrangement would cut off the necessary light near the lamp post and hence would be impracticable. This difficulty could be met by cutting away the lower portion of the reflector. But this arrangement is not yet all that is desired because it directs the light in only one direction instead of two directions 180° apart as required. This condition may also be met if the parabolic reflector is cut through vertically in the focal plane and a similar reflector also with its lower half cut away is placed back to back with the first. This results in a structure which does not obstruct the natural illumination of regions near the lamp and which by redirecting light otherwise wasted builds up the illumination in the dark parts of the street.

An objection may be made to this arrangement on the grounds that a parabolic mirror throws a nearly parallel beam of light. Consequently the effect of the proposed arrangement would be to illuminate only a small area of the street by the rays coming from the mirror; that is, at a point midway between the lamps there would be a little bright patch which would amount to nothing as far as the general illumination goes, while the surrounding portions of the street would be left in darkness as before. This objection would be a very valid one provided we had a very small source of light in the focus of the mirror. Then the effect would be that of a searchlight beam. What we actually have in practice with the tungsten lamp is quite an extended source. The result of this is that the beam of light is a divergent one and at the distance where it is effective, it covers a considerable area. The angle of divergence of a beam of this character is equal to the angle which is subtended at the mirror by the source of light. It is found in practice that this angle is sufficient to cause reflected rays to cover all the area of the street surface which is required.

The idea which is developed above of using two semi-parabolic mirrors pointing in opposite directions, may evidently be extended to include three or four or more. It is clear that this reflector would not be so effective in any one direction as is the two direction reflector, because the luminous flux is divided by four rather than by two. Still the gain resulting from the use of this reflector would undoubtedly be very considerable.

The results of tests of reflectors of this character have indicated that the improvement in street illumination with a given amount of light generated is a very marked one, varying from 50 per cent to several hundred per cent. Thus in this simple way, another important apparatus is put into the hands of the illuminating engineer with which to cope with the problems with which he is confronted.

A limitation of all apparatus of this character, which send a concentrated beam of light to illuminate the street, is that they produce a somewhat objectionable glare in case the fixture is near the roadway. This glare is inseparable from the concentrated beam, and consequently from the high efficiency which a reflector of this kind yields. Where the reflector can be placed high above the street, its efficiency still is high and the glare is less objectionable, because the light does not fall so directly in the eye. A similar objection holds with arc lamps. In the case of both illuminants the elevation of the illuminant above the street is in many cases prevented by the presence of shade trees which would cut off the illumination in case the fixture were put high in the air. It remains, therefore, in many cases, for the illuminating engineer to choose between higher efficiency and diminished glare. It will be seen, therefore, that the limitations which hedge in the illuminating engineer in laying out street lighting are also considerable, and that there is in this field, as well as in the field of interior illumination the need for the exercise of trained experience.

SOME APPLICATIONS OF ELECTRICITY IN THE IRON AND STEEL INDUSTRIES.

By Brent Wiley.

Logically the subject of motors for the auxiliary apparatus should be discussed first as the history of the development of electrical applications in the iron and steel industries follows along this line, and it will lead naturally to the principal point to be emphasized; namely, the advantages of electricity to these industries.

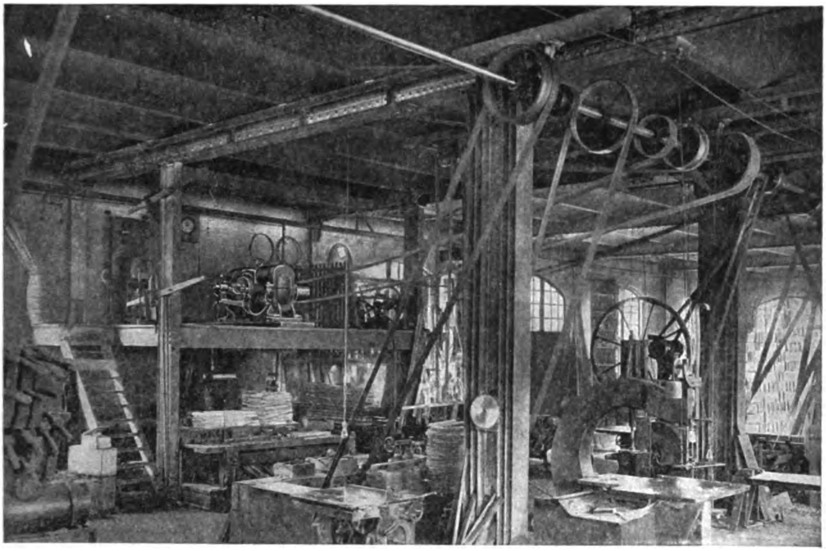

Figure 1.

For the past twenty years the use of electricity in iron and steel mills has been increasing. The historical development probably began as early as 1882, with the installation of a two light arc dynamo in the Edgar Thompson Works of the Carnegie Steel Co. In 1889 an electric crane was installed in the Pencoyd Iron Works, and in 1891 a 50 hp., 250 V., compound wound DC generator and three 220 volt motors were installed in the Edgar Thompson Works on an experimental ingot crane. These machines are illustrated in Figures 1, 2, and 3., and they are still in use, the generator being belted to the main line shaft of the carpenter shop, as illustrated in Fig. 1. One of the motors, which is a Westinghouse 25 hp. type No. 29, is geared to an Ingot pusher as illustrated in Fig. 2. A second motor, which is a 3 hp. Manchester type, is belted to a line shaft, which drives a grindstone and an emery wheel, as illustrated in Fig. 3; and a third motor which is a Westinghouse, 30 hp., type No. 3, is used on a Soda Ash Hoist of a water settling tank.

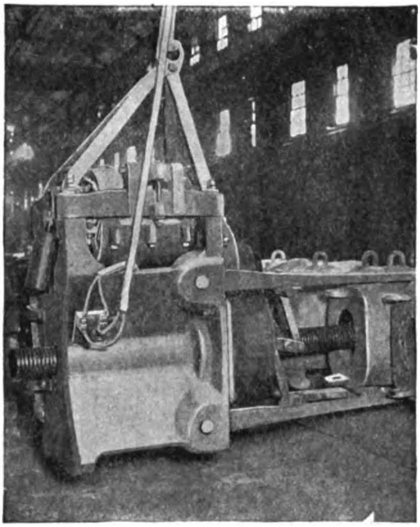

Figure 2.

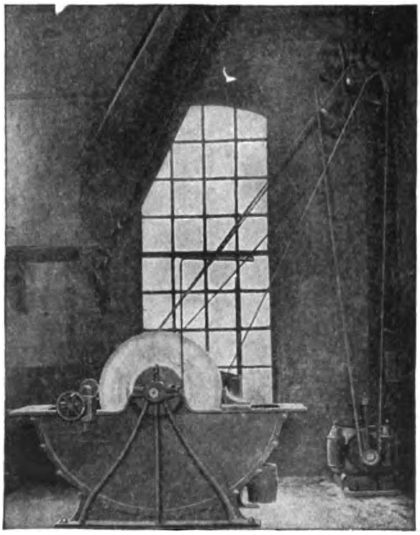

Figure 3.

The history of these machines gives a splendid idea of the durability of electrical apparatus in general and illustrates their adaptability which is one of the principal economical features.

While the motors available at first did not have all the required mechanical and electrical characteristics, they suggested many possibilities, and motors were soon developed more in

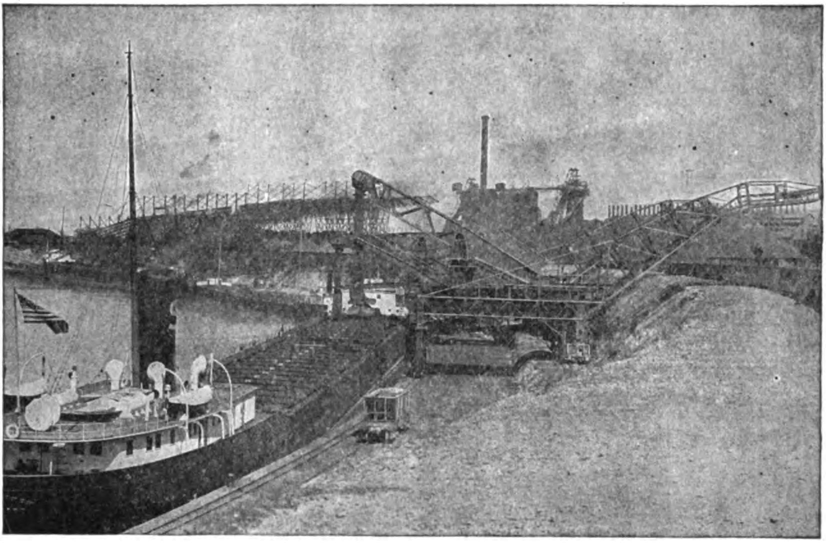

Figure 4.

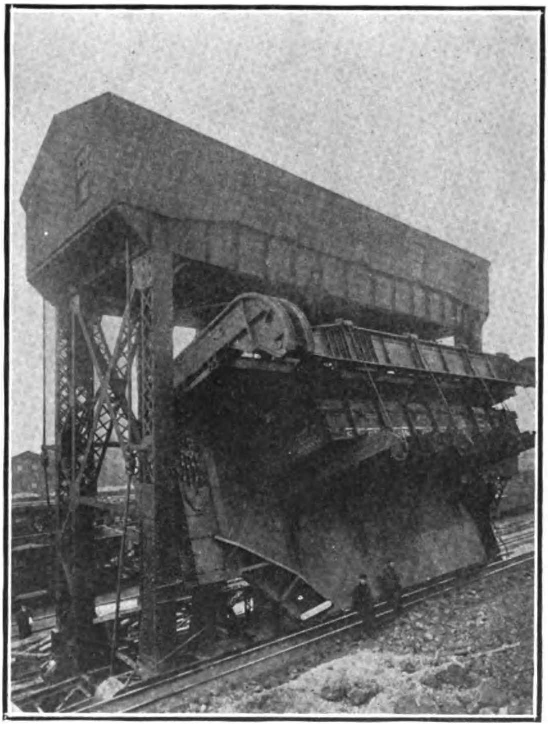

Figure 5.

line with requirements. Improvements have been made as their need became manifest until the modern mill motor leaves little to be desired.

Where a plant is located on a waterfront, the ore is received by boat and conveyed to the dock by means of an ore unloader as shown in Fig. 4, and in case of an inland point, the ore is received by rail. The cars are emptied into larry cars by means of a car dumper shown in Fig. 5, and is deposited, either in the bins located near the blast furnaces or into the ore yard for stocking. The ore bridge distributes the ore received during the summer time in the yard and reloads it during the winter for distribution in the bins. The ore, limestone and coke, which form the burden of the furnace, are carried from the bins to the skip-hoist by means of scale larry cars.

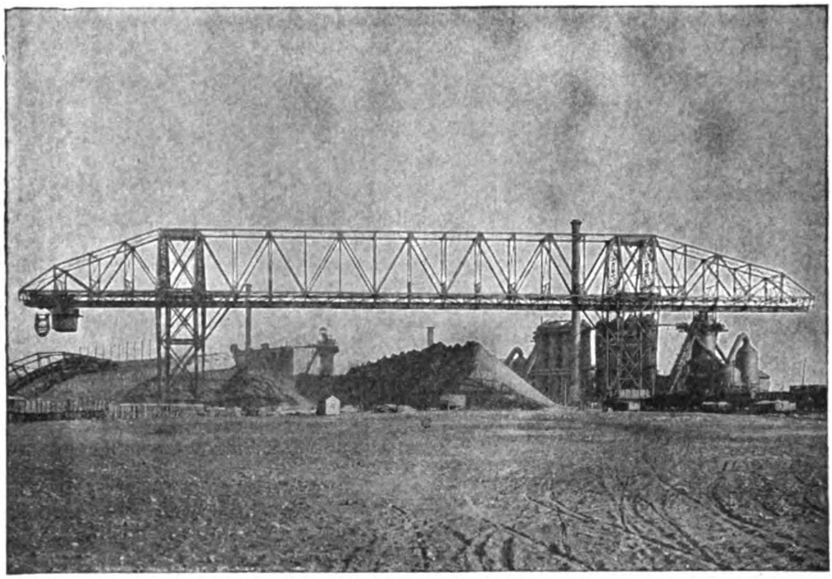

Figure 6.

The hot metal from the blast furnace is either cast into pig, or sent to the mixer which is merely a large hot storage furnace of approximately 200 to 500 tons capacity, or is taken direct to the open hearth furnaces of the steel plant for immediate use.

Several of the principal motor driven machines of the blast furnace department are illustrated in Figs. 4 to 9 inclusive. In the most modern plants, motor drive is used for the following applications:

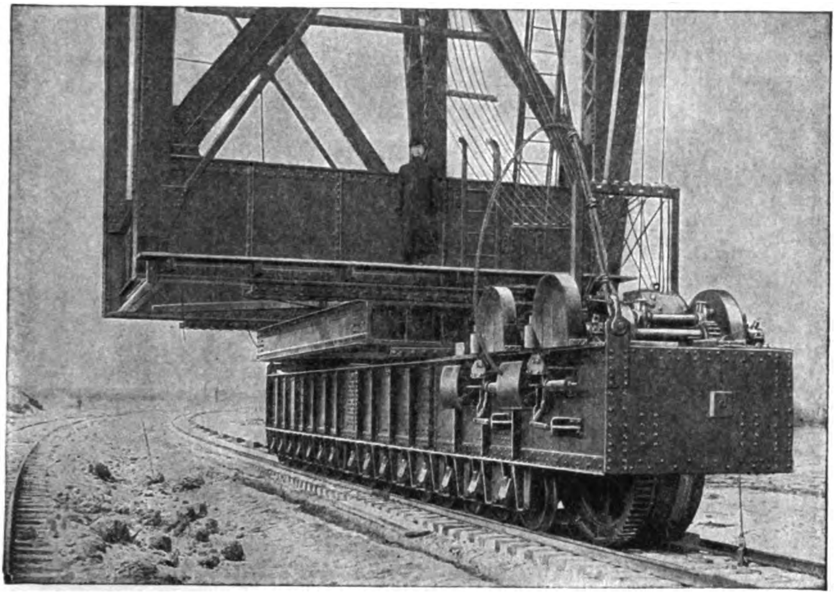

Figure 7.

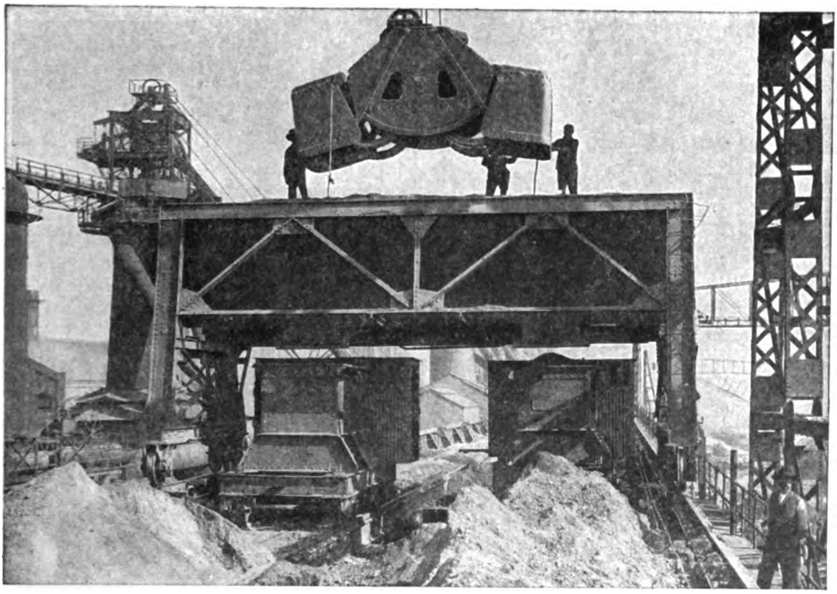

Figure 8.

Ore unloader;
Car dumper;
Larry transfer car;
Ore bridge;
Scale larry car;
Skip hoist;
Pig casting machine;
Overhead traveling crane;
Fan;
Gas Washer;
Machine shop;
Pump.

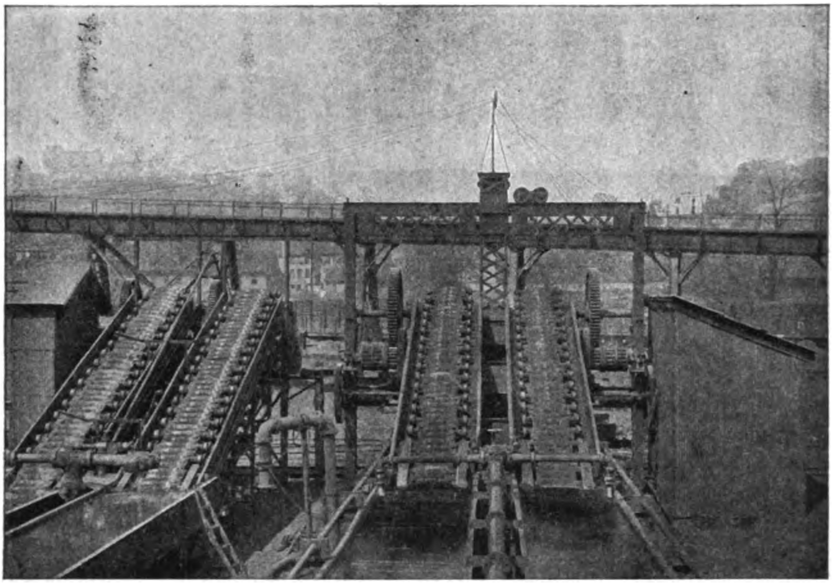

Figure 9.

In the Steel Mill Department the metal from the blast furnace is used in the Bessemer Converter in the form of pig iron, or is used in the molten state in the Open Hearth furnaces. The steel is poured into a mould to form an ingot and then goes to the stripper where the mould is removed. The ingot is then placed in a soaking pit, which brings it to the desired uniform rolling temperature. Fig. 10 gives a plan view of No. 2 Rail Mill—Illinois Steel Co., South Chicago, and this illustration, with a list of the motor driven machines in the modern steel plant will give a general idea of the operation required from the blast furnace to the shipping department.

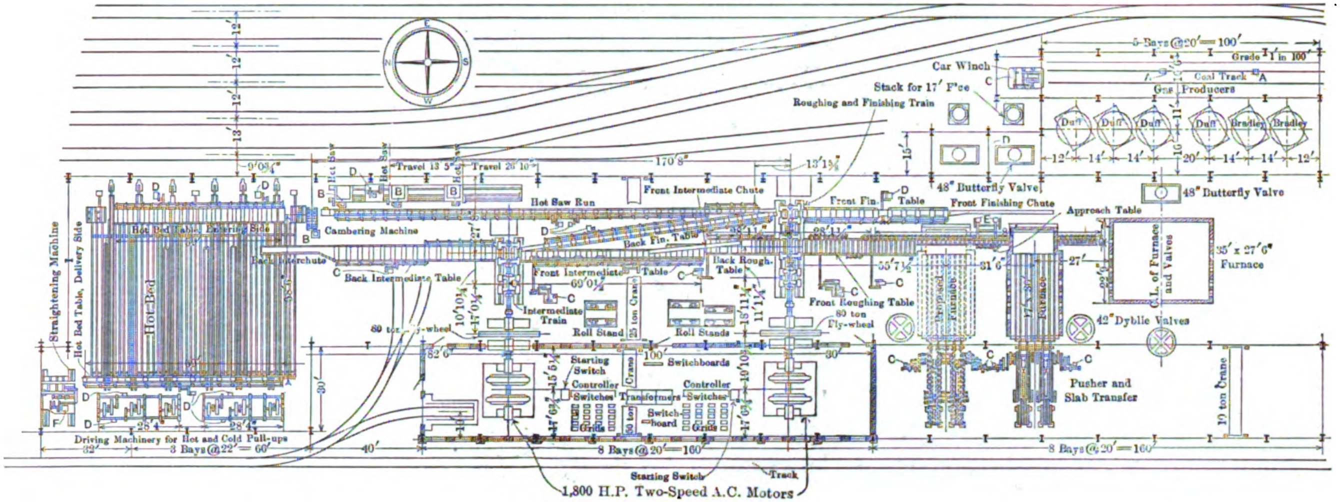
5 Bays @ 20′ = 100′
Grade 1′ in 100′
Coal Track
Gas Producers
Duff
Duff
Duff
Duff
Bradley
Bradley
Car Winch
Stack for 17′ F'ce
Roughing and Finishing Train
48″ Butterfly Valve
48″ Butterfly Valve
Approach Table
35′ x 27′6″ Furnace
C.L. of Furnace and Valves
Furnace
Proposed Furnace
42″ Dyblie Valves
Pusher and Slab Transfer
10 ton Crane
8 Bays @ 20′ = 160′
Front Finishing Chute
Front Fin. Table
Front Intermediate Chute
Hot Saw Run
Travel 13′ 5″
Travel 26′ 10″
170′ 8″
13′ 1½″
Hot Saw
Hot Saw
Hot Saw
Cambering Machine
Back Fin. Table
Back Rough. Table
Front Roughing Table
80 ton Fly-wheel
80 ton Fly-wheel
Front Intermediate Table
Intermediate Train
Back Intermediate Table
Back Interchute
Roll Stand
Roll Stands
25 ton Crane
Switchboards
Starting Switch
Controller
Switches
Transformers
Switch-board
Grids
50 ton Crane
Hot Bed
Hot Bed Table, Entering Side
Hot Bed Table, Delivery Side
Straightening Machine
Driving Machinery for Hot and Cold Pull-ups
3 Bays @ 22′ = 66′
8 Bays @ 20′ = 160′
Starting Switch
Track
1,800 H.P. Two-Speed A.C. Motors

Figure 10.

Open Hearth Dept.—

Charging machine;
Hot metal crane;
Ladle crane;
Furnace door;
Stripper crane.

Steel Mill Dept.—

Soaking pit crane;
Approach table;

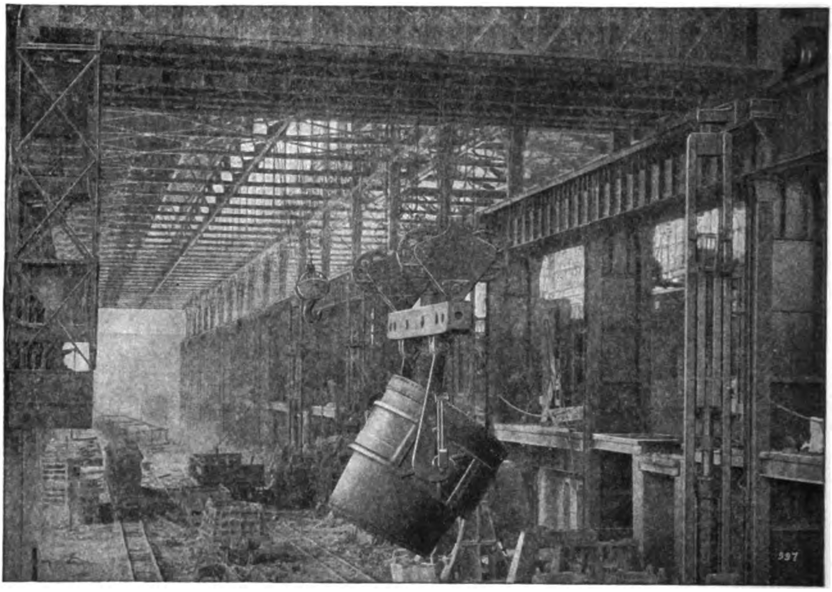

Figure 11.

Mill table;
Screw-down (on rolls);
Shear or hot-saw;
Run-out table;
Transfer;
Straightening machine;
Shipping crane.

General Applications—

Machine shop;
Carpenter shop.
Coal crane;
Skull cracker crane;
Pump;
Gas producer;
Ash hoist.

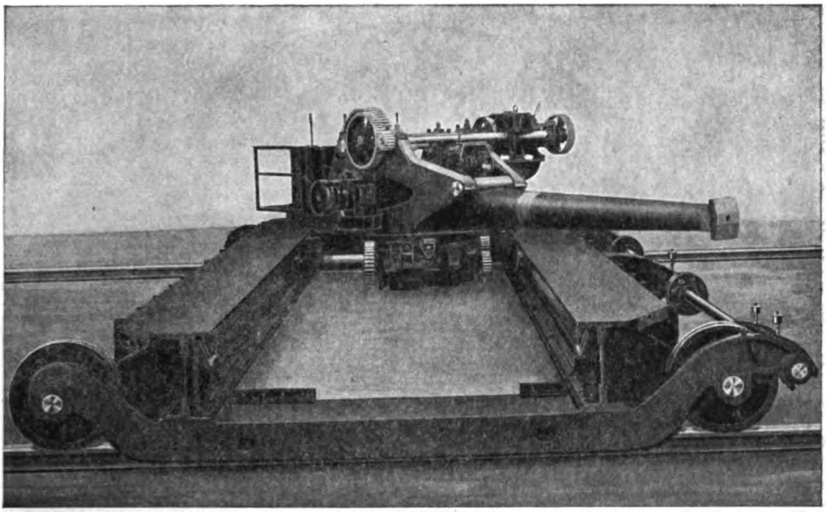

Figure 12.

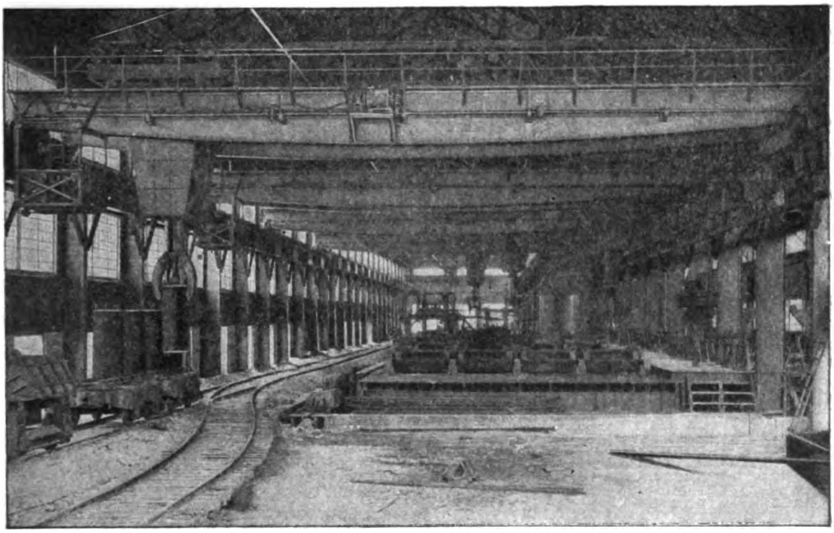

Figure 13.

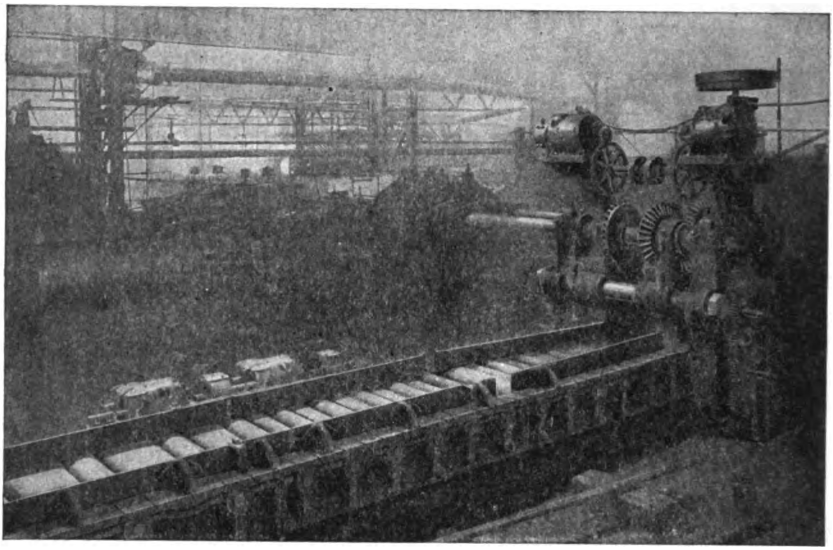

Figure 14.

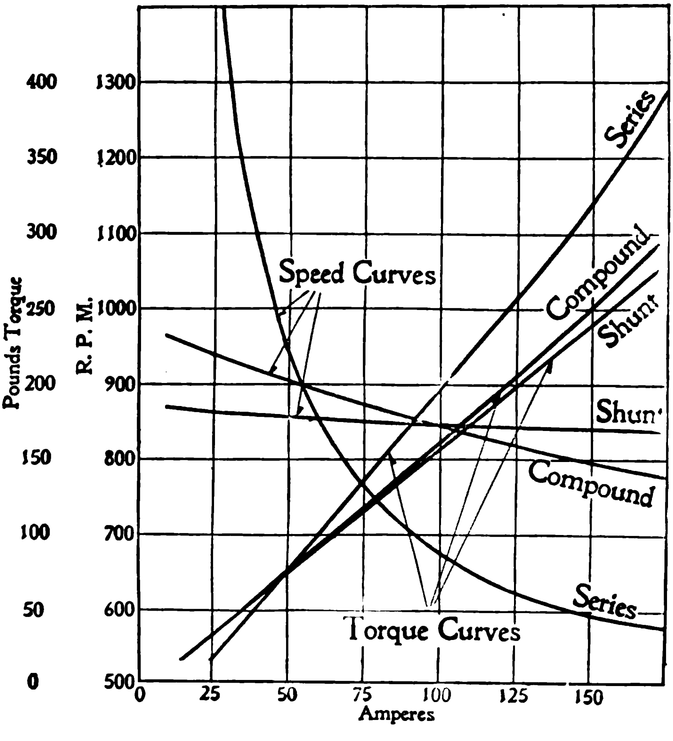

Figure 15.

Figs. 11 to 14 inclusive illustrate several of the principal applications.

The advantages which the use of electricity offers to the Iron and Steel industries are:

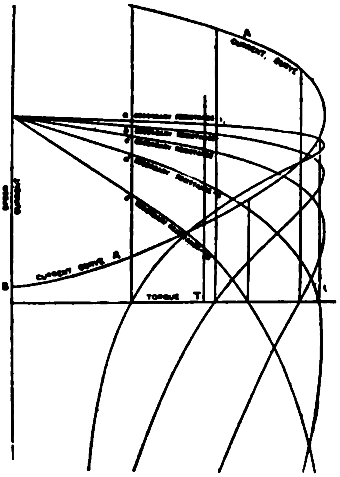

Figure 16.

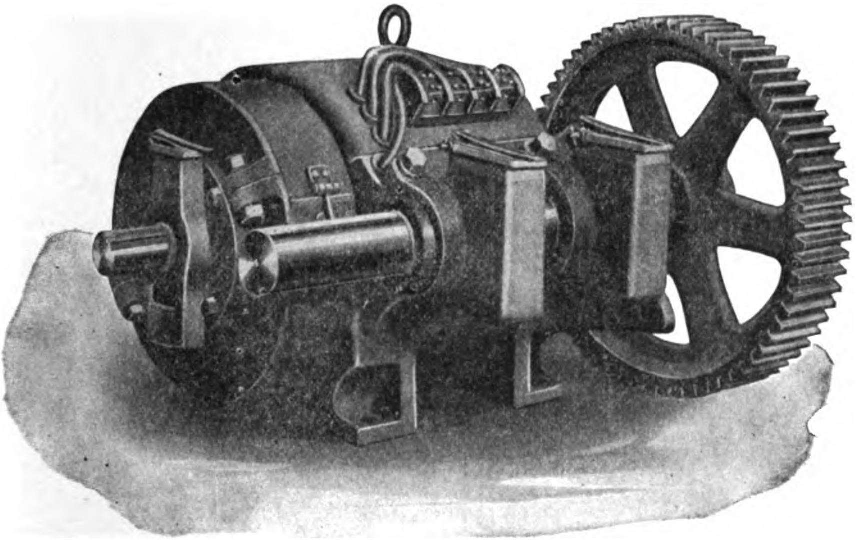

Figure 17.

(1) Easy distribution of power by means of electric cables instead of steam or water pipes.
(2) Easy adaptation to mill machinery.
(3) Wide range of characteristics of motor, making it suitable for every class of work.
(4) Ease of control.

One of the most apparent advantages of electric motors is the ease of power transmission, especially to traveling motors. The transmission of steam or water pressure to isolated devices is complicated, expensive, troublesome and for traveling motion, in some cases almost impossible; whereas electric wires or cables can be readily installed in unobtrusive places to lead to any part of the yards or mills for stationary or traveling motors.

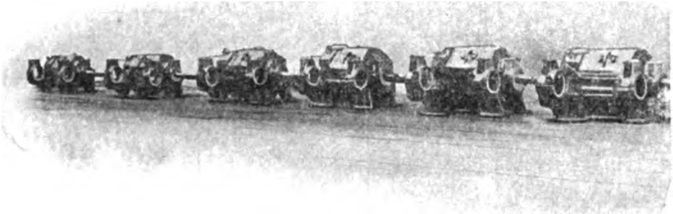

Figure 18.

The next three advantages mentioned, namely: 2, 3, and 4, are evidenced by the large variety of motor driven machines and the wide range of applications now given the motor. We now have universally electrified steel mills and there is great activity in the extension of electric drive in all the large existing mills. In the case of new propositions, this subject is given every consideration and is often adopted instead of steam drive.

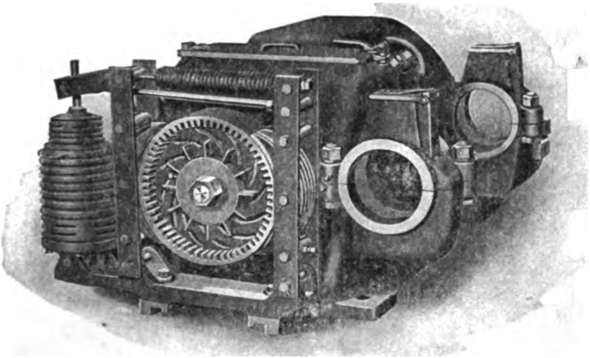

Figure 19.

It will be well to review the details of the motor characteristics, which makes it desirable for this work;—these being compactness, small size and weight due to the high speed, durability, suitable speed torque features and range of speeds covered.

Figs. 15 and 16 illustrate the speed torque curves of direct current and alternating current motors respectively.

All machinery having a very intermittent and reversing load is suitably driven by a direct current series of motor, and included in this class are tables—screw-down, transfers and cranes which embrace ore bridges, strippers and many other machines.

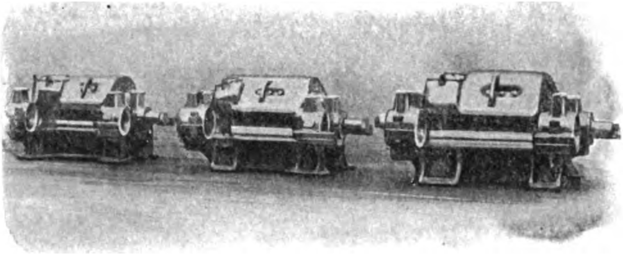

Figure 18.

Two modern types of direct current motors particularly suitable for steel mill service are illustrated in Figs. 17 and 20 inclusive. The type "K" motor is especially suitable for crane service, being of compact design, and having strong mechanical features and excellent overload electrical capacity. The frames are steel with the exception of the two smaller sizes and they are built with and without counter-shaft brackets.

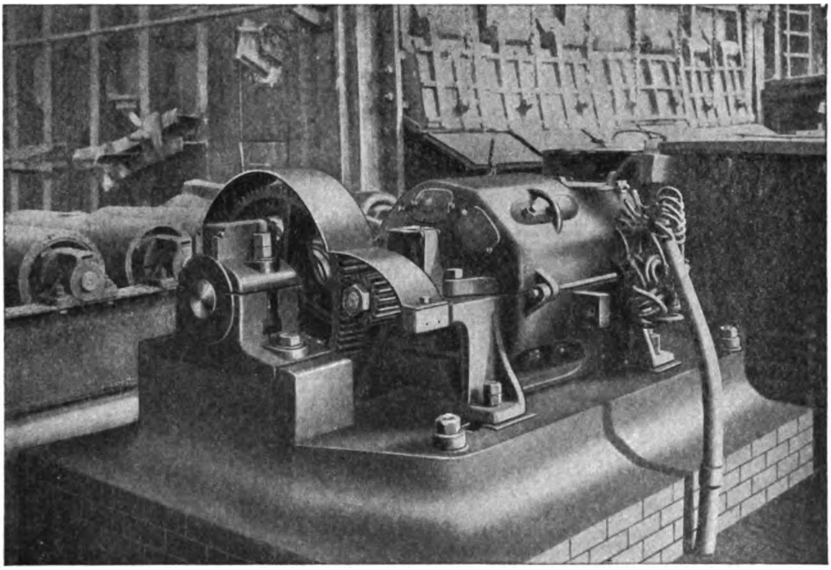

Figure 20.

The "MT" motor is of a very rugged design with exceptionally heavy shaft and well braced frame. The speeds are moderate and the gearing of such ratio that low speeds can be obtained for the counter-shaft. The insulation is of fireproof quality and is strong mechanically. For the majority of mill applications a series motor is suitable, but where the load is light and motor may run for a considerable period, a limiting speed is essential. A compound winding can be supplied for the "MT" motor, which will give a no load speed of approximately twice the full load speed. This is well within the maximum safe speed limit as motors of this general type should stand at least three times full load speed.

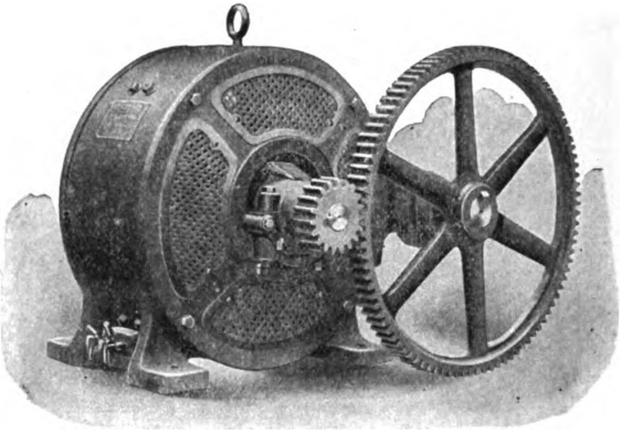

Figure 21.

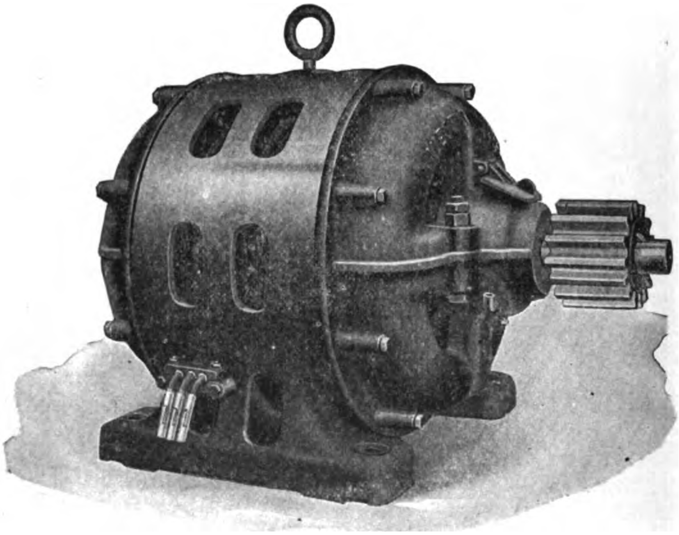

Figure 22.

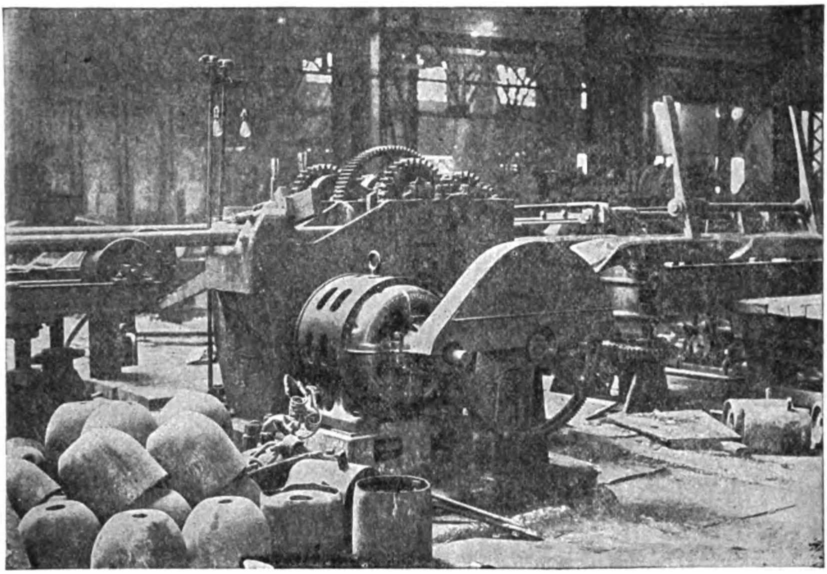

Figure 23.

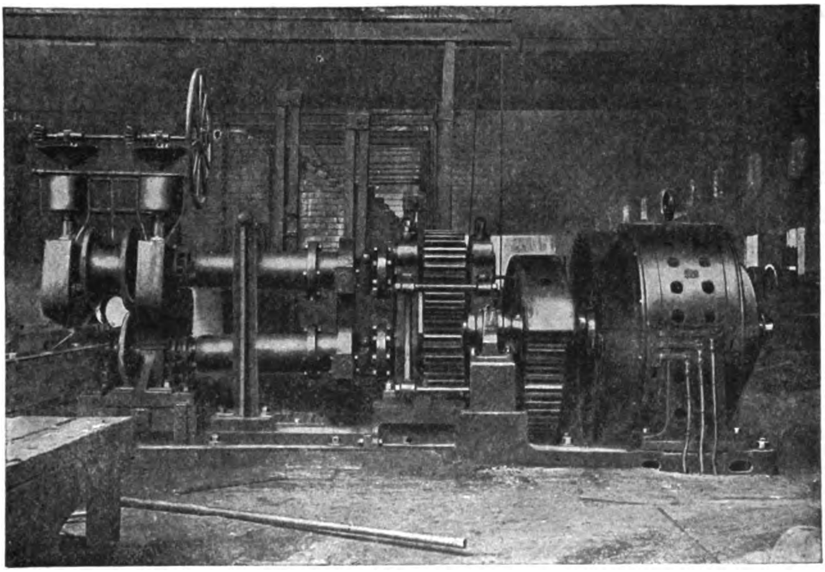

Figure 24.

For constant speed work, including machines of the Finishing Department, such as straightening press, saw, shear and machine tools, other types of motors are more suitable. Shunt and compound windings are used for direct current motors and for the majority of cases, a squirrel cage winding is used for alternating current motors. The wound rotor type motor is used only in case speed variation is required, or where the starting conditions are extremely severe, and it is desired to start the motor with the lowest possible current from the line; as for instance, where large motors, such as a 150 hp. or 200 hp. and larger sizes are used on machines, which have a large fly wheel capacity, or for other reasons require a large starting torque. There are very few of these applications.

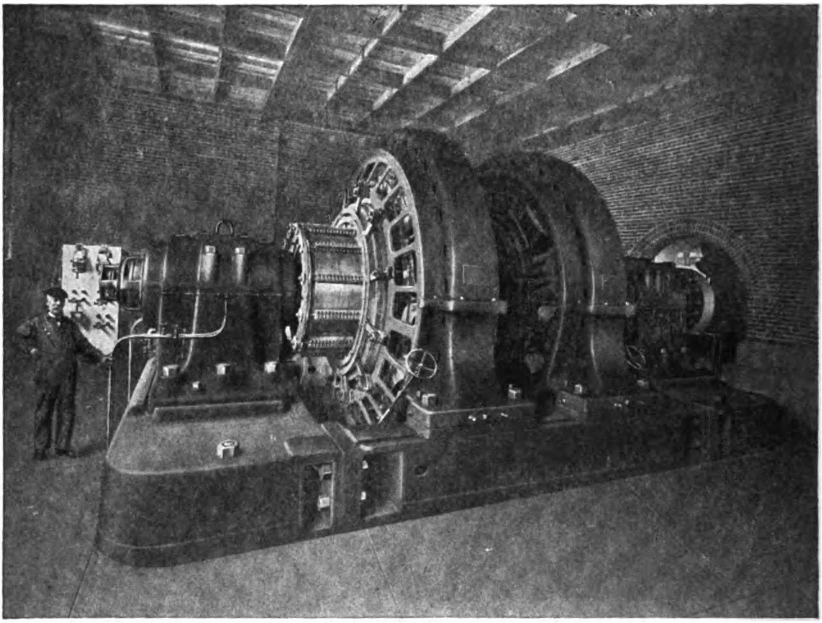

Figure 25.

Figs. 21 to 24 inclusive show details and applications of both direct current and alternating current motors as mentioned above.

Considering the question of universal motor drive, electricity offers two other important advantages, namely:

(1) Advantages of centralizing power.
(2) Motors offer the following advantages where used on main mill drive:

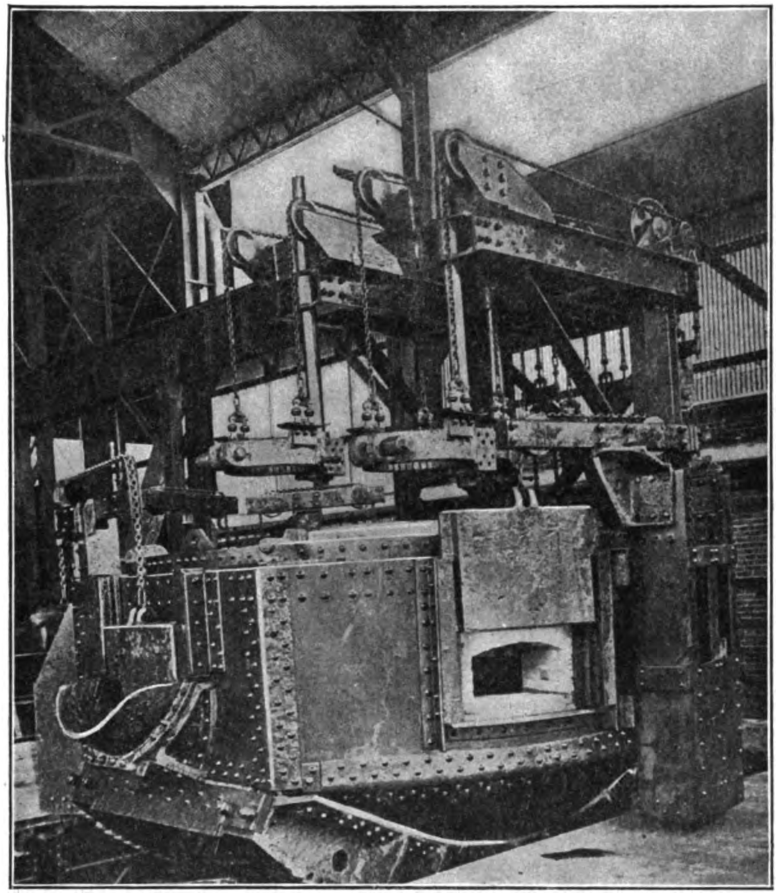

Figure 26.

Side View of 15-Ton Heroult Electric Furnace at South Chicago.

Constant and regular torque;
More reliable, less breakage of couplings, pinions, etc.
Less room on account of absence of boilers;
Easy and simple handling;
Less labor;
Lower fuel costs;
Less oil and other stores;
Permits the use of gas engines of medium size in power-house;
Increased output due to higher speeds;
Ease of obtaining power indications and records.

Large motor drive for the main rolls was first adopted in this country about six years ago, the initial installation being at the Edgar Thompson Works and consisting of two 1500 hp. 220 volt compound wound direct current motors, 100 to 125 pm. connected to rolls for finishing right rails.

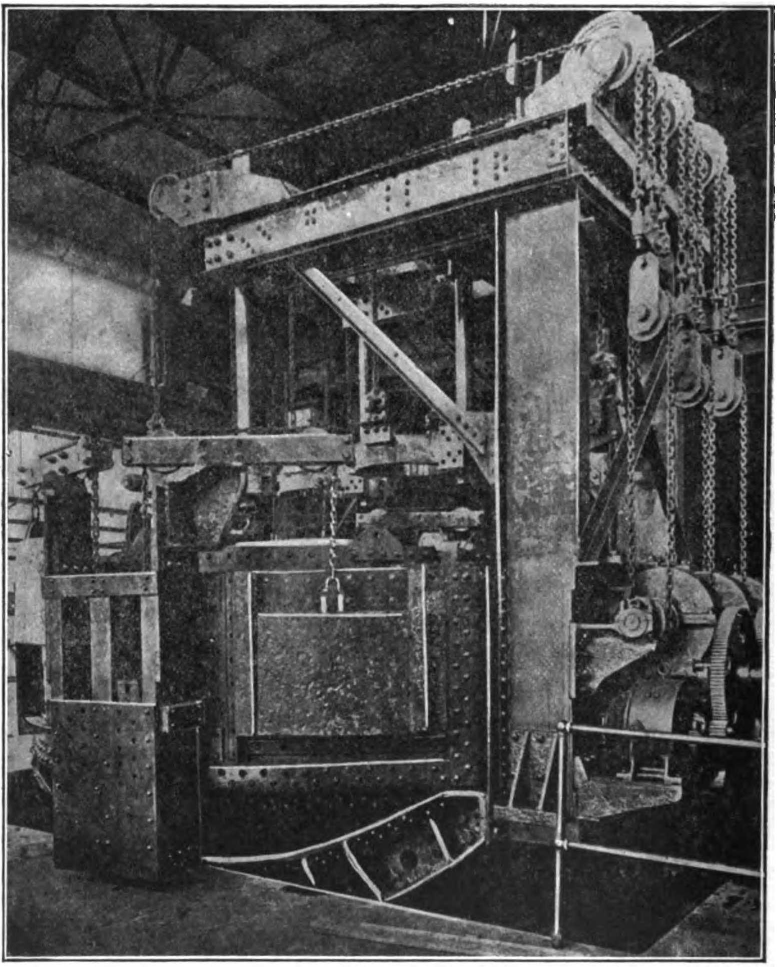

Figure 27.

Rear View of 15-Ton Heroult Electric Furnace at South Chicago.

Fig. 25 shows the large motors used for driving the main rolls and the table of applications is convincing evidence that electricity is fast becoming a more and more important factor in the steel industries and is due recognition of the advantages offered by this method of drive.

Cheap power is supplied by gas engines using blast furnace or coke oven gas and also by low pressure steam turbines using exhaust steam from mill engines. The latter applies mostly to existing plants rather than new mills. More than 200,000 hp. of these two classes of engines have been installed in this country.

In a recent steel mill proposition a detailed comparison of first cost and operating cost was worked out for both direct steam drive and for electric drive, using low pressure turbo units on exhaust steam from other mill engines. The first cost of the electric proposition was approximately twenty-five per cent. higher than the steam drive, but the fuel saving alone amounted to the difference for an eighteen months run. The electric drive was adopted.

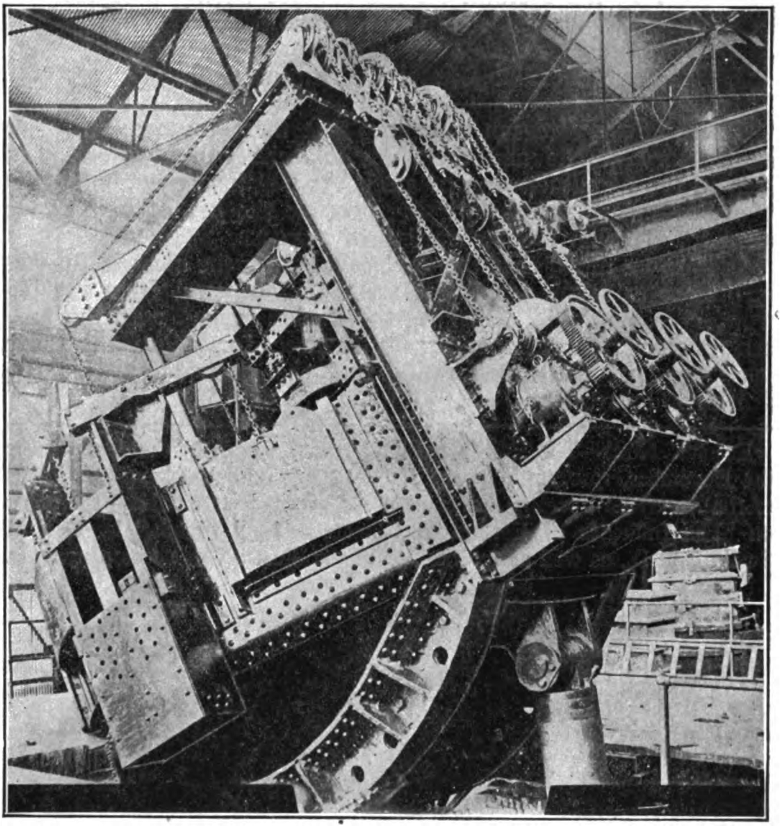

Figure 28.
15-Ton Heroult Electric.
Furnace in Inclined Position.

The electric furnace for the refining of steel has been in practical use abroad for several years and has proven a great success.

During the last three years several furnaces have been installed in this country, namely:

Halcomb Steel Works, Syracuse, N. Y.
  1-4-ton electric furnace.
Firth Sterling Steel Co., Demmler, Pa.
  1-250 kw. electric furnace, 3 tons capacity.
  1-120 kw. electric furnace, 1½ tons capacity.
Illinois Steel Co., South Chicago, Ill.
  1-15 ton Heroult electric furnace having a capacity of 500 tons of steel in 24 hours.
American Steel & Wire Co., Worcester, Mass.
  Same as Illinois Steel Co. furnace.

There is every reason to believe that these furnaces will give satisfactory results and their development will mean a great step in the manufacturing of steel. It will insure better quality at a lower cost, thereby making possible the use of high grade steel for a much greater variety of purposes.

It is to be noted that the field covered by the electric furnace is limited to refining and not to making of steel from the pig iron. We, no doubt, will have the duplex system with the Bessemer converter or open-hearth furnace for doing the large percentage of the transforming and the electric furnace as a finishing department.

EDITORS' NOTE.—The Editors wish to call attention to the fact that in the November, 1910, issue of the JOURNAL, credit should have been given to the American Forestry Association for permission to publish the paper on "The Influence of Forests on Climate and on Floods," by Geo. F. Swain, LL. D., as well as for the use of the illustrations accompanying it.

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ROAD WORK IN PENNSYLVANIA AND SOME OF ITS PROBLEMS.

BY JOSEPH W. HUNTER.

The Dark Ages of Public Road History.

Pennsylvania is an empire in itself for within her borders is practically produced all the anthracite coal mined in the United States, about 70,000,000 tons per year. The greater percentage of bituminous coal is mined within her borders and the major part of coke consumed is made here. More than fifty per cent. of steel of the United States is made in Pennsylvania plants; one-half of the locomotives manufactured in the United States are built in the city of Philadelphia. Important parts of the nation's war ships are built within our limits. We have some of the richest counties on this continent and we stand high among the agricultural states of the Union and in the front row of manufacturing communities. In the matter of good roads and easy method of transportation we are, however, far behind sister states that have not the material advantages we possess.

It has been said, "The roads of a county are accurate and certain tests of the degree of its civilization and their improvement keeps pace with the advance of the nation in numbers, wealth, industry and science." While this may have been true fifty or sixty years ago, yet to-day it can hardly be said, with truth, that the improvement of the public roads of Pennsylvania, as a whole, has kept pace with the advance of the State in numbers, wealth, industry and science; and one is forced to the conclusion that there is more in precept than in practice.

The centers of wealth and industry depended entirely upon the rural and farming communities to maintain the public roads without any assistance, until the burden became so great, that the country districts have been unable to cope with the problem, and in many instances the public roads, by reason of the lack of funds with which to maintain them, are in a worse condition than they were twenty or thirty years ago. The system of turnpikes or toll roads, inaugurated in 1800, gradually developed and extended over the whole State until there was a net work of fairly good roads that permitted of travel during the entire year. This system of turnpike roads was maintained and served the purpose until the advent of railroads, which soon became competitors for hauling the freight that was transported over them.

This loss of traffic caused many turnpikes to be abandoned and the failure to properly maintain others caused them to be condemned, and they were paid for by the county which they traversed. The care of the abandoned and condemned turnpikes was put upon the township supervisors, who, in many instances, entirely neglected them, and these roads to-day are the worst to be found in many counties and are absolutely dangerous and practically impassable.

The period from the advent of the railroad to the present epoch of road construction may be termed the "Dark Ages" in the history of our public roads.

The State Highway Department.

About 1885 there began an awakening in some of the eastern counties of Pennsylvania as to the necessity of having better roads. Under the movement then inaugurated and which was stimulated by the University of Pennsylvania offering $700 for prize essays on the subject of "Better Roads," several miles of roads were reconstructed in the counties adjacent to Philadelphia, wholly at the expense of the townships in which the roads were located. In 1895 an act was passed authorizing counties to issue bonds for the reconstruction of township roads and to maintain them afterwards, thus relieving the townships of the portion of the burden under which they were laboring.

The State Highway Department was organized under Act of General Assembly, approved April 13, 1903, and reorganized under Act of May 1, 1905. Under these acts the work of reconstructing township roads has been carried on in the several counties of the State.

The Act of May 12, 1909, supplementing the act of April 12, 1905, placed, in a large measure, the overseeing of the maintenance of the earth roads throughout the State, and the Department is confronted with the problems of reconstructing the township roads and the maintenance and building up of the 9,800 miles of dirt road in a territory 288 miles east and west and 162 miles north and south containing 45,215 square miles.

During the fiscal year ending May 31, 1909, there was collected and expended in the State of Pennsylvania upwards of $18,361,617.49 for the construction and repairs of streets, roads and bridges, about $5,000,000 of this sum was used for so-called repairs to township roads.

The Art of Road Making.

Sir Henry Parnell says: "The art of road-making must essentially depend for its success on its being exercised in conformity with certain general principles; and their justness should be rendered so clear and self-evident, as not to admit of any controversy."

Rapidity, safety and economy of carriage are the objects of roads. They should, therefore, be so located and constructed as to enable burdens of goods and passengers to be transported from one place to another in the least possible time with the least possible labor, and with the least possible expense.

To attain these important ends, a road should fulfill certain conditions, which the nature of the country over which it passes, and other circumstances, may render impossible to unite or reconcile in one combination; but to the union of which we should endeavor to approximate as nearly as possible in forming an actual road upon the model of this ideally perfect one.

Every road, other things being equal, should be perfectly straight, so that its length, and therefore the time and labor expended in traveling upon it should be the least possible. An excess of length adds to cost of construction, cost of repairs, and time and labor in traveling over it.

Every road should be as level as possible, and as a road can in few cases be at the same time straight and level, these two requirements will often conflict. In such cases straightness should always be sacrificed to obtain a level road or to make a road less steep.

The horizontal length of a road may be advantageously increased to avoid an ascent by at least twenty times the perpendicular height which is thus saved; that is, to avoid a hill one hundred feet high, it would be proper for the road to make such a detour as would increase its length two thousand feet. The mathematical axiom that "a straight line is the shortest distance between two points" is not a safe guide in road making, and less appropriate than the proverb that "the longest way around is the shortest way home."

Some Problems.

Few existing roads are well located. They are built after the style of the Romans, going over the hills rather than around them, and it is a difficult matter to have the alignment changed. Property owners who have established their residences along the road oppose a change of location, and, then again, the property owners whose land would be taken by the change ask such excessive damages that at times it becomes more desirable to cut down a hill than to seek a change in alignment in order to secure an easier grade.

It is desirable, if possible, to have no grade of more than three and a half per cent., but with varying surfaces in the State this is found to be impracticable, and for short distances in some localities we have been fortunate in reducing a 15 or 20 per cent. grade to a 10 per cent. grade.

On the Old Hazleton and Nescopeck turnpike at Conyngham, Luzerne county, by change of alignment which increased the length of the road 925 feet, the old grade which ran from 5 to 16 per cent. was reduced to 8 2-3 per cent. as the maximum and 2.46 per cent. for the minimum.

It can readily be understood that where a road passes over a hill which could be removed to advantage it is practically useless to do so when just beyond is a hill the grade of which is greater than the one that could be readily changed, but which grade cannot be materially lessened either by a change of alignment or by cutting.

Another advantageous change of grade was obtained by passing a plane through the side slope of an old road and lowering the roadbed on the hillside, thus providing a solid bed for the stone road. The worst problem to contend with in this case was the slips from the uphill side of the road. These hills consist of decomposed shale and are from two to four hundred feet in height and the bottom of the ravine 80 to 130 feet below the road. After a rainy spell a portion of the hill slipped on to the road and twice a portion of the road slipped into the ravine. The slips were finally overcome by using cribbing at one point and at the other point by the method as shown on the diagram. A trench was cut along the side of the road next to the hill toward a central low point, drain tile was placed in the bottom of the trench which was then filled with broken stone to within two feet of the top and then finished with a concrete gutter to catch the surface water from the hill and conduct it to a catch basin at the point where the under drainage was concentrated and passed through a pipe under the road with an outlet at the toe of the slope in the ravine.

The work of reconstructing township roads must be confined to the legal width of the road as ordered to be opened by the Court. This width is usually 33 feet, sometimes 40 feet, and in a few instances, 50 feet. The lack of sufficient width is at times a serious hindrance both in the matter of grading and drainage. By erosion and abrasion the roadbed that originally had been on a level with the earth on either side of the road has become depressed in many instances from two to ten feet, or more, forming a channel for the rain water which, as a usual thing, is permitted to flow in the center of the road in many cases from 300 to 3,000 feet before an outlet can be obtained.

Drainage.

The secret of all road building is to secure a dry, solid foundation upon which to place the road metal or broken stone. In order to do this the water must be kept out of the road and away from it. While the 32nd Section of the Act of June 13, 1836, provides that "The supervisors aforesaid shall also have power and authority as aforesaid to enter upon any such lands or enclosures and cut, open, maintain and repair all such drains or ditches through the same as they shall judge necessary to carry the water from the said road," there has been considerable difficulty at times in enforcing this section of the general road law in opening up such drains as are absolutely necessary to properly drain the road to be reconstructed and, in some instances, the provision of Section 67 of said act, which provides "If any person shall stop, fill up or injure any drain or ditch, made by any supervisor for the purpose of draining the water from any public road or highway, or shall divert or change the course thereof without the authority of the supervisors for the time being, such person shall, for every such offense, forfeit and pay a sum not less than four dollars nor more than twenty dollars," has been enforced.

There is no State in which the cost of drainage is so large in proportion to the total cost of the road reconstructed as in Pennsylvania. The extensive water sheds, the many mountain and hillside roads, and general configuration of the surface of the State makes the expenditure of a large sum of money necessary for proper drainage. In some instances this outlay has been as high as $9,556.80 and as low as $150.00 per mile, with an average of $1,557.60 per mile. Tile and stone are used to drain sub-grades, being placed in the side ditches or in the center of the road. Many hills that show a wet sub-grade are drained by a herring-bone system of tile drains, extending alternately from the center to either side and placed as occasion demands, 25 to 50 feet apart. Cast iron, corrugated metal or concrete pipe or concrete box culverts are used to convey the water from the high to the low side of the road and also to carry the water in small streams across the road. "Thank-you-ma'ams" are abolished. Corrugated metal pipe if made of "Ingot iron" is a serviceable pipe, excepting where it is subjected to the action of sulphur water. Concrete pipe or concrete box culverts can be placed for about the same cost as corrugated pipe and are generally used where a culvert or drain of twenty-four inches or more is required.

The Conneautville Bridge.

Bridges are made of reinforced concrete, rubble cement masonry, and plate girders with concrete floor. To my mind, the stone arch or reinforced concrete structure is more in harmony with the landscape, and therefore more suitable for use in road reconstruction than the stiff steel plate girders. Following are some details of a reinforced concrete arch bridge erected over Montgomery Run at Conneautville, Crawford county. The old bridge was a through timbered truss, with iron tension members resting on dry masonry abutments.

The span of the arch is 50 feet and the rise 6 feet 9 inches from the springing line of arch, making a very flat structure with a great horizontal component at the skewbacks. The road traffic carried by the bridge is heavy, and the stream crossed at this point is unique for its turbulent floods, followed by intervals of low water. The foundations were to be carried to a depth of four feet below bottom of the stream. The top stratum was found to be gravel, interspersed with boulders; this in combination with the water made excavation difficult. The pits for the abutments were, however, dug and borings made to determine the nature of the underlying strata. The drill brought up quicksand in both pits, to a depth of from eight to twelve feet on the west side, and to a greater depth on the east side. Piles were driven on both sides in sufficient number to carry the entire vertical reactions of the bridge. Concrete, the consistency being a hand-mixed, semi-dry, or dry, 1-3-5 mixture, was deposited by means of a slide, until above water, after which it was shoveled directly into the pit and pushed gently off the top of the heap into the water. The latter was retained by means of small earth dams so as to prevent loss of cement. The sand was mixed dry three times with the cement and then the broken stone wetted and turned four or more times with mortar. The concrete was well tamped and spaded, and while the concreting progressed, work was pushed on the forms and centers. The ribs were built and assembled on a platform over a full sized drawing, the material being green maple; bolts were used for the joints. Eight-inch by ten-inch timbers make the compression chords and 2-inch by 8-inch and 3-inch by 8-inch planks the tension chords. The nature of the stream made it necessary to support the ribs at the ends only, so as to leave the waterway unobstructed. The trusses, eight in number, rested upon pairs of wedges, which in their turn rest upon a horizontal 8-inch by 8-inch stringer supported by transversely braced posts, resting on mud sills laid over transverse blocks on the bottom of the stream. The lagging was matched and planed 2-inch hemlock boards, nailed in place. When the concreting reached the springing line of the arch, the composition of the mixture was changed to 1-2-4, owing to the coldness of the weather, and this mixture was used exclusively until the bridge was completed. Whenever fresh concrete was deposited upon already hardened surfaces the latter was cleaned throughly and given a coating of neat cement for a binder. Johnson corrugated bars having an ultimate tensile strength of 65,000 pounds or more per square inch were used in the reinforcing.

The bridge cost $2,603, or fifty-seven dollars ($57) more than the estimated cost.

This figure shows the continuation of the northeast wing wall of the 50 foot clear span reinforced concrete arch bridge just described. Its peculiar construction is due to the fact that about five feet below the stream the gravel stratum rests upon quicksands. The expense of piling for foundation to allow the erection of a solid wall would be too great. A line of piles could, however, have been driven and allowed to stick up high enough to form a retaining wall, but the appearance of a bank of this kind would not harmonize with the bridge, neither would it last very long, nor would it recommend itself as being economical. The wall has overcome these various difficulties, as it does not require a solid footing, hanging as it is in the bank itself; it is economical and permanent, and presents a surface harmonizing with the general outline of the bridge. The question "Will it stand up and fulfill its functions?" was given full consideration and solved as follows:

Taking the part above A-A, in accordance with the prevalent theory of earth pressure, there is a maximum resultant pressure of about 122 pounds per square inch, while concrete is considered good for 300 pounds per square inch. The weight of concrete is taken at 150 pounds per cubic foot, and that of the earth backing at 100 pounds per cubic foot. There would be no tension, the resultant falling within the middle third, but to be on the safe side we will consider the horizontal component by its lever arm, which gives a bending moment of 5,580 inch-pounds. This, if made to equal the internal moment, will require a lever arm 3.45 inches long, if bars one-fourth of an inch square are spaced 6 inches center to center, and if the tensile value of the iron is equal to 12,000 pounds per square inch and the compressive value of concrete equals 122 pounds per square inch as above. This would require a slab only 6½ inches thick at the base, while we have 1 foot 9 inches. If the bars are stressed to the maximum, they will not pull loose at the bottom, as it would require more than 3,000 pounds per bar to rip the transverse bars to which it is hooked, through the concrete. The bars are increased to the three-eighths of an inch square as the hook on the one-quarter inch bar would not be strong enough. The horizontal shear along line A-A is amply taken care of. It would require at least 10 pounds per square inch to drag the ledge B horizontally through the ground; the horizontal components above and below A-A can never accomplish this. In case of water freezing above A-A, the inclined back of the wall would allow the ice to slide up rather than push right out. Weep holes are provided, as per sketch, to prevent freezing as far as possible. The horizontal slab below A-A sustains nothing but horizontal tension equal to the sum of the horizontal components above and below A-A; that is, providing it and the ledge B are resting on unyielding soil. In case of settling of one form or another the slab will sag and perhaps crack at the center or the ends, but the reinforcing bars, which are arbitrarily chosen, will amply take all horizontal tension, and they, in combination with the earth fill, will prevent any overturning above A-A.

The perpendicular slab below A-A carries about 1,200 pounds direct compression, being the vertical component resulting from the loading above A-A; the horizontal component is taken care of by ledge B. The vertical component plus the dead weight of the slab equals 1,800 pounds or 2,700 pounds per square foot, which is not very high for a gravel bed about four feet deep. In case of a tendency to sink, the horizontal slab will prevent it from going far. There is a slight horizontal component at top and bottom, caused by the backing, but this is amply provided for, as is the bending moment at center. The rods are spaced in accordance with the Department's standard for slabs under such loading. A range in temperature of about 100 degrees is taken care of by longitudinal rods aggregating in total cross-section a 1/600 part of the cross-section of the wall; twelve bars three-eighths of an inch square are distributed through the section for this purpose. This demonstrates that the wall will safely carry all the earth pressure imposed upon it during changes of temperature and a three winters' test shows that it will also resist the pressure caused by freezing above or below line A-A.

Elastic Concrete Arch Viaduct at Scenery Hill.

This picture shows a type of structure rarely seen in the United States. It is a reinforced concrete arch bridge, treated by the designer as a perfectly elastic structure. The stresses are determined as securately as in any steel structure, and the material provided to carry these stresses is loaded to the ultimate limit permitted by the factors of safety. The bridge is known as the Scenery Hill Viaduct, and carries the National or Cumberland Pike 90 feet over the Ellsworth Branch of the Pennsylvania Railroad. The transverse width C.-c. parapets is 36 feet, and the total length of the floor is 140 feet. The theoretical span on the natural axis is 97.334 feet, the rise 36.387 feet, and the form of curve is a parabola. The concrete work is in accordance with the State Highway Department's standard Specifications for concrete work, and the reinforcing material is subject to the requirements of the Manufacturers' Standard Specifications.

The live load consists of a 15 ton roller for the floor and its supports; and 100 pounds per square foot on roadway, and 80 pounds per square foot in sidewalks, for the columns and arch ribs. There are three parallel arch ribs 18 feet c.c. Their cross-section at base is 4 feet 8 inches by 16 inches for the two outside arches, and 4 feet 8 inches by 22 inches for the middle arch; at the crown the dimensions of outside arches are 3 feet by 16 inches and of the inside arches 3 feet by 22 inches. The three arch ribs are rigidly fixed at both ends, and have no hinges or joints. The outside ribs are reinforced by means of 16 rods 1⅛ inches in diameter, and the center rib by means of 24 rods 1⅛ inches in diameter. These ribs carry ten panels of the floor by means of columns which support the cross beams on which the floor slabs and longitudinal floor beams rest. The floor slabs are seven inches thick and are supported by cross beams 20 inches by 10 inches, and longitudinal beams 14 inches by 8 inches, these latter being supported by the 20 inch by 10 inch cross beams; the slabs are of 9 feet 10 inches by 9 feet 8 inches spans and are, like the beams, reinforced for positive and negative bending moments as well as shears. The floor slabs are considered stiff enough laterally to take up all the stresses induced by a wind load equal to 50 pounds per square foot of exposed surface. The columns are all rigidly fixed at both ends, and this fixedness of ends of columns is considered as equalizing the demand for diagonal bracing; it was considered best to use a higher factor of safety for the columns than for any other part of the structure. The reinforcement in columns provides for bending stresses, diagonal shears and direct compression. The tallest column is 30 feet 3 inches in clear, least side 14 inches. The maximum positive bending moment at left support of arch ribs is produced with maximum temperature and the live load extending from right support to the center of second panel to the left of crown. The maximum negative moment obtains under the reverse condition of external forces. The ribs are in direct compression, only when there is no live load on the viaduct. A live load introduces the above mentioned bending stresses. The diagonal shearing stresses are provided for by means of lacing similar to that used in the columns. The floor extends beyond the arch rib footings for a distance of two panels where it rests on the abutments, so that one set of columns at each end are resting on the ground. The abutments and wings are vertical slabs, designed to hold the 22 foot high earth fill; these slabs are supported by means of vertical cantilever beams anchored in horizontal slabs held down by their own weight and the weight of the fill resting upon them. Any horizontal motion is prevented by a vertical ledge 14 feet deep. Weep holes are provided at the junction between the horizontal and vertical slabs. The abutments are, as a matter of safety, connected to the bases of columns resting on the ground, and to the arch rib footings by means of three inclined struts parallel with the ground. Fixedness of such struts, as well as ends of columns and arch ribs, is obtained by imbedding the reinforcing material to such a depth that the adhesion between it and the concrete equals the tensile strength of the bar.

The bridge floor is level, and carries a 26 feet wide driveway paved with concrete on a cinder bed. The gutters are two feet wide and drain into the ravine below by means of catch basins 19 feet apart. There is a 5 foot sidewalk on each side, protected by a parapet 6 feet thick, which carries a two strand 2½ inch galvanized pipe railing 3 feet 6 inches high. The form work was so satisfactory that no surface trimming of any kind was needed beyond a light wash to give a uniform color to the entire structure.

On the 28th of April, 1909, the bridge was inspected by the Department, Joseph U. Crawford, Engineer of Branch Lines of the Pennsylvania Railroad Company, together with other engineers and officials of the Pennsylvania Railroad. During the presence of these gentlemen tests were made on floor slabs and arch ribs to ascertain their behavior under the maximum live loads. The results of these tests, however, faded into insignificance when compared with a test which was entirely unexpected and caused by a misunderstanding on the part of the field forces. Orders had been issued to use the intended paving material as a uniform load over half the span, and to distribute same to a depth of 2 feet 6 inches over the loaded area. The material (broken stone weighing about 100 pounds per cubic foot) had, however, been placed to a depth of 7 feet 6 inches to 8 feet, this equaling a uniformly distributed load of six times the allowable live load. The maximum deflection under this excessive load amounted to a sinking at the haunches on the loaded side of 5/16 inch and a 3/16 inch rise of the haunches on the unloaded side of the viaduct; this load had been on the bridge for over 72 hours when removed, after which the viaduct resumed its original shape. To attempt to calculate the ultimate capacity of the bridge from these deflections would require a greater knowledge of the united action of steel and concrete when subjected to stress than that derived from present practice. Also it would be necessary that every part of the bridge, even its minutest detail, should be in practice as it is assumed in theory. Since the structure resumed its original shape it seems fair to assume, however, that its elastic limit was not exceeded, but may have been very dangerously approached, that if the ultimate capacity of the bridge would be twice its elastic limit, one may say that a bending moment of about 58 million inch pounds would produce rupture in the middle arch. A deflection test was made on one of the slabs in the following manner: A box 6 feet by 6 feet by 6 feet was placed on a wooden block 1 foot 6 inches by 1 foot 6 inches over the center of the slab. This box was then filled with material weighing about 100 pounds per cubic foot, and the resulting deflection in the slab recorded. To prevent overturning, the box was supported on its four edges while being loaded, thus distributing the load over an area of 6 feet by 6 feet. The deflection under this condition of loading was equal to 0.059 inches. The blocking was then removed and the entire load concentrated on the 1 foot 6 inches by 1 foot 6 inches area which resulted in a deflection of 0.0642 inches. This load was left on the bridge 24 hours. Upon removal of same the slab resumed its original shape.

The stresses in the arch ribs were determined by means of Howe's Summation formula, and the stresses and section of the remaining portions of the structure formed and composed by means of the Department's method as formulated by G. A. Flick, Engineer of Bridges for the Department and engineer in charge of the bridge. The structure was built at a cost of $16,840.00 by the Hennebique Construction Company of New York, R. Baffrey, President. The force employed in constructing the bridge in 120 days consisted of a superintendent, three foremen, a hoisting engineer and on an average seven carpenters and eighteen laborers. The road surfacing was designed by the State Highway Department and consisted in water-proofing the floor slabs by means of a coat of tar, on top of which was deposited a layer of cinders 8 inches deep at the crown and 2 inches at the gutters; on top of this was placed a 4 inch layer of 1-3-5 concrete, maximum size of stone 1½ inches for wearing surface. Beyond the abutments for a distance of 120 feet on each end of the bridge the wearing surface rests on a 5 foot layer of 1-3-7 concrete, maximum size stone 3 inches. The total cost of the surfacing was $1,757.90.

Suitable Material For Road Construction.

The selection of suitable material for road construction is a problem that has required much thought, and is to-day one of serious consideration and might alone be given several hours of study and discussion. There are mountains of stone in the State, but the natural deposits of stone that make a good road surface are scarce. For heavy traffic roads a harder stone should be used than on a light traffic road. Trap rock, of some variety, is properly the best known stone for use on heavy traffic roads leading out of cities and other centers of population. About one-third of the twenty-eight varieties of limestone are suitable for road purposes, but usually make first class macadam roads for medium traffic and are more easily kept bonded and ravel less in dry weather. The sandstones are, in themselves, seldom fit for road surfacing, but when bonded with limestone make a good road and will withstand a fairly heavy traffic. The shales found throughout the State are of little use for road purposes, except for very light traffic, the Marcellus shale of Pike county giving the best results. In Bulletin 79 of U. S. Department of Agriculture Mr. Page says, "To obtain the best results on a macadam road that rock should be selected which would resist the wear of the traffic to which it is subjected to such a degree as to supply just the sufficient amount of binding material to cement the road. Too much or too little wear are alike injurious. The higher the cementing value of the rock the smaller the wear necessary. When a road is first constructed a sufficient amount of binding material must be supplied to cause it to "come down" under the roller or traffic. If the subsequent traffic is not sufficient to wear off the requisite amount of binder to replace that carried off by wind and rain the road "ravels." If the traffic wears off an excess of binding material, mud and dust result. In either case the material is not well suited to the conditions. In the first case a softer rock should be used; in the latter, a harder, tougher rock, and in all cases a rock of high binding power. For example, if a country road or city parkway, where only a light traffic prevails, were built of a very hard and tough rock with a high cementing value, neither the best results nor the cheapest, if a softer rock were available, would be obtained. Such a rock would so effectively resist the wear of a light traffic that the amount of fine dust worn off would be carried away by the wind and rain faster than it would be supplied by wear."

Many roads where hard stone has been used and the traffic is not sufficient to keep the material bonded can be kept from raveling by applying limestone screenings to the surface.

A telford-macadam or a macadam road alone has and will withstand the ordinary vehicle traffic, but under the motor vehicle traffic to which the reconstructed road is now subjected other methods of surfacing a road will have to be adopted. It is a very difficult matter to decide on just what such surfacing should consist of being at the same time resilient enough to accommodate vehicle traffic and to resist the force of the rapidly-moving motor traffic. In the middle and western part of the State brick roads are advocated as the only material with which public roads should be reconstructed. Some roads have been reconstructed with brick and give satisfaction, withstanding both horse vehicle traffic and also motor traffic. They do not, however, make an ideal country road, and cost considerable more money to build than the telford-macadam road. The yearly cost of maintenance is less than that of the macadam road, unless absolutely neglected by the supervisors whose duty it is to care for and maintain them.

The use of a bituminous binder with the macadam course of stone seems in a measure to meet the demands for a waterproof and dustless road that will be of sufficient resiliency to accommodate all kinds of travel. A method of applying the bituminous binder that is both satisfactory and economical has not as yet been adopted; experiments have been made with varied results. The only safe and economical method is to incorporate the bonding material with stone used in the reconstruction of a road. Either bricks or this latter method of construction will undoubtedly be adopted as best suited to accommodate the traffic in suburban districts adjacent to thickly populated centers, and the latter method will, within the near future, be used in the rural or country districts on the main or much traveled roads. The latter method will cost at least one-third more than the ordinary telford-macadam road; the maintenance will probably cost less.

Conclusions.

The question arises as to who should pay the additional cost of the bituminous-macadam construction. It is not just that farmers or citizens of rural districts be asked to bear the burden of the added cost of such construction when an ordinary telford-macadam road will well accommodate them and give them the needed facilities for travel, while the necessity for the additional or more expensive method is caused by the use of the motor vehicles should be required to pay such a license or registration or maintaining such a road and, in fact, in many instances pays no tax anywhere that is used for road improvement or maintenance. If roads are built which accommodate motor traffic and add to the pleasure of the motorist then the owners of motor vehicles should be required to pay such a license or registration fee as will materially aid in the maintenance of the roads.

The first reconstruction work of the Department was commenced April 13, 1904, in Monroe township, Snyder county.

There have been completed 731.6 miles of road, at a cost of $8,307,192.50 including bridges, with 95 miles of road under contract. The average cost per mile being $11,354.83 including bridges; excluding bridges $10,564.00 per mile.

During the year 1909 there was reconstructed 163.5 miles of road at an average of $12,460.00 per mile, including bridges and roads upon which bricks were placed. Brick paved roads cost

$17,273.27 per mile and the macadam roads, exclusive of the cost of bridges and brick, $10,454.40 per mile.

The average cost of additional work was 3.3 per cent. of the contract price; the cost of inspection was 2.9 per cent. and the cost of engineering 2.2 per cent. of the total cost of the work. Engineering expenses do not include the salary of the engineer in charge, but do include his traveling expenses.

There are now on file 2,386 applications asking for the reconstruction of 4,762 miles of road throughout the State.

The primary move in asking for the reconstruction of a road must be made by the supervisors of a township. This system gives isolated sections of reconstructed roads the longest section of improved road, being 14.2 miles. In order to get rid in a measure of the patch work system now being followed and to provide for a system of continuous improved highways, the Legislature should adopt such a plan as will authorize the reconstruction of main roads or trunk lines throughout the State, following in the main the present highways and eventually connecting by improved roads the several centers of population, county seats, principal cities and towns. These trunk lines will require the reconstruction of about 3,000 miles of roads and the cost of such reconstruction and maintenance afterward should be paid for entirely by the State. No better investment could be made; the value of good roads is incalculable. The improvement of these roads will greatly benefit the rural districts, will invite strangers to be our guests, and will afford our citizens an opportunity of seeing the most fertile fields and the grandest scenery to be found any where in the world, and which to-day remains hidden and unknown to but few. We believe that with a system of good roads connecting centers of population and extending to the State line in all directions and connecting with similar systems in adjoining States there will be inaugurated an era of good feeling and fellowship, of easy communication and intercourse that, as the years go by, will more firmly weld and cement the bond that unites us in the sisterhood of States.

SOME STEAM TURBINE CONSIDERATIONS AND RECENT EFFICIENCIES.

By Edwin D. Dreyfus.

From the standpoint of power production, the present age is veritably a steam turbine era when we consider the rate of manufacture of these machines in units of capacity in relation to other types of prime movers. While the gas engine, hydraulic turbine and reciprocating steam engine may each in turn possess the greater advantage for certain conditions, in the majority of instances, present economic considerations dictate the use of the steam turbine for power generation.

The remarkable growth of the turbine industry is particularly noteworthy. With but few exceptions, the turbine has displaced the reciprocating engine in all important steam-electrical stations. The turbine is making rapid inroads, even in marine work—this stronghold of the reciprocating steam engine, and by reason of the higher efficiencies made possible in marine application by the use of reduction gears, it is safe to predict that the future power in marine vessels will be mainly supplied by the turbine. Other developments are under way which point toward the possible use of reversible and variable speed turbines geared to shafting in which field the reciprocating engine has been so successfully applied, as well as in condenser and boiler feed service. Compactness and simplicity are the "desiderata," and these are the distinguishing features of the turbine. The relative merits of the turbine and the reciprocating engine, as regards floor space and steam economy, have been so thoroughly discussed hitherto as to require no further elaboration. This is likewise true of the theory and fundamental principles of the turbine which have already been exhaustively treated.

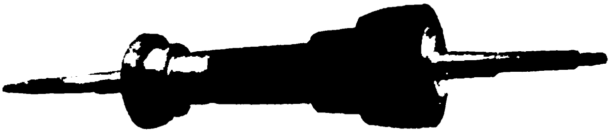


Fig. 1.

The intent of this paper is primarily to show some important features and improvements in construction that have developed with extended experience, and also noteworthy efficiencies that have been obtained, both under test and actual service conditions.

It is quite necessary in this connection, to exhibt various steam economy records in order that a proper conception may be had of the striking progress in the art. The high efficiencies and excellent operating performances have directly followed the introduction of the advanced designs, and these merit attention.

Rotative Speeds: Turbines are essentially high-speed machines, and the speed of rotation in stationary practice is determined by the generator in electric service. For alternating current work, the following revolutions per minute have been used:

Poles.	60-Cycle.	25-Cycle.
2	3,600	1,500
4	1,800	750
6	1,200	....
8	900	....
10	720	....

Small machines of the reaction type of 500 kw. and under, have been designed to run at 3,600 r. p. m. for 60-cycles even since the turbine became a commercial product. Limitations in the electrical art previously confined the rotative speed within 1,800 r. p. m. for sizes above 500 kw. However, recent improvements in the design and construction now permit the use of higher speeds for the machines of larger capacity. To-day turbines of 2,500 kw. are very satisfactorily operating at 3,600 r. p. m. And it is to be expected that we will soon have 4,000 kw. turbines of the same rotative speed. The recent developments in materials and design establishes the departure from the former slow speeds to be thoroughly approved practice. In the generator, the rotor design and the materials have been modified to possess a large factor of safety over and above the centrifugal stresses produced. In high-speed work, generator rotors of the through shaft type have been largely superceded by designs having the shaft bolted to the ends of the field disc by means of non-magnetic coupling in two-pole machines, and integral with either half of the rotor in four-pole machines, and the whole secured by through bolts. Quite

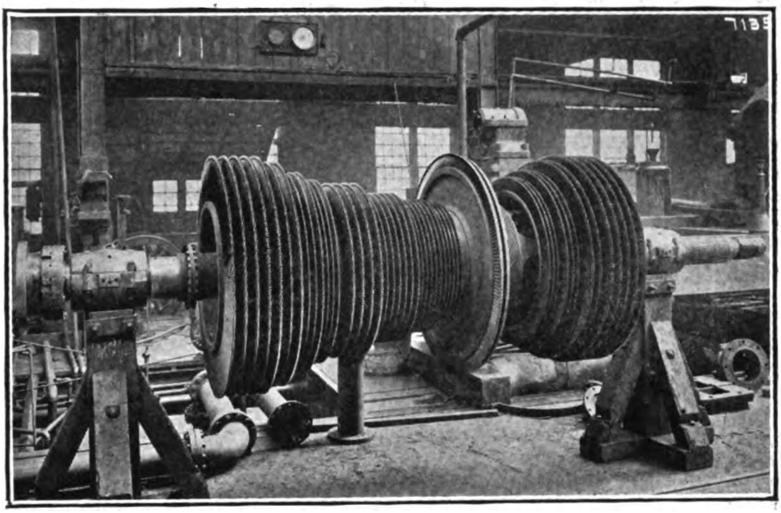


Fig. 2.

singularly, in the high-speed turbine the problem of the mechanical strength is simpler, in a measure, than in the low-speed turbine. The maximum blade or peripheral speeds are practically the same in both machines, but naturally with the smaller masses in the higher speed machine, there is more surety of homogenity of metal, and consequently the smaller diameter rotor could, if desired, be made to withstand higher strains. The spindle also becomes about 30% shorter.

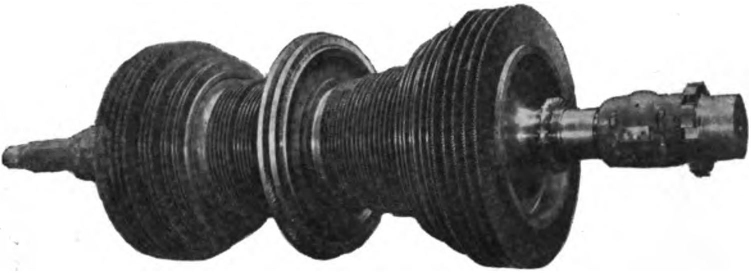


Fig. 3.

The effect of rotative speed is forcibly brought out in the accompanying Table I which gives the principal dimensions on two 1,000 kw. standard turbines,—one to operate at 1,800 r. p. m. and the other at 3,600 r. p. m.

Table I.

Comparative Dimensions.

	Low Speed	High Speed
1,000 kw. Turbine.	1,800 r. p. m.	3,600 r. p. m.
Length between bearings, approx.,	12′ 7½″	8′ 8″
Size of bearings, approx.,	6″ x 14″	4″ x 9″
Weight, including blading, approx.,	7,000 lbs.	2,000 lbs.
Maximum drum diameter, approx.,	3′ x 1¼″	20″
Minimum drum diameter, approx.,	17¼″	10¼″
Number of rows of blading, approx.,	82	49
Largest blades (nominal height),	4″	4″
Shortest blades (nominal height),	¾″	½″

Coincident with the improvement in mechanical construction, a betterment in economy of 3 to 5% has resulted, due to altered distribution of steam and more favorable blade lengths.

A conception of the change in dimensions of the turbine may be had by comparing Figs. 4 and 5, which show longitudinal sections of 10,000 kw. turbines of 1,800 and 750 r. p. m., respectively, reduced to the same relative scale.

An example of the improvement in efficiency actually accomplished, is furnished by tests of four 1,000 kw. turbines for the United States Navy Yards and authenticated by a Government representative. In Table II are included the final results obtained with two machines, each of 1,800 and 3,600 r. p. m. respectively, operated at 150 lbs. ga., 100 deg. Fahr. superheat and 28 inches vacuum (30″ bar.):

Table II.

Test Results of 1,000 kw. Turbines at 1,800 and 3,600 r. p. m. Comparison of Official Witness Tests.

Turbine Number	401	402	Avg.	709	170	Avg.	P. C. Im't.
Date of Test	Feb. '07	Jan. '07		Aug. '09	Aug. '09		
	Speed 1,800 r. p. m.			3,600 r. p. m.			
One-half load,	20.4	19.93	20.17	19.58	19.00	19.29	4.4
Full load,	17.15	17.50	17.33	16.79	16.30	16.55	4.5

The gain, both in regard to dimensions and efficiencies, apply to larger units equally as well as the 1,000 kw. machines compared.

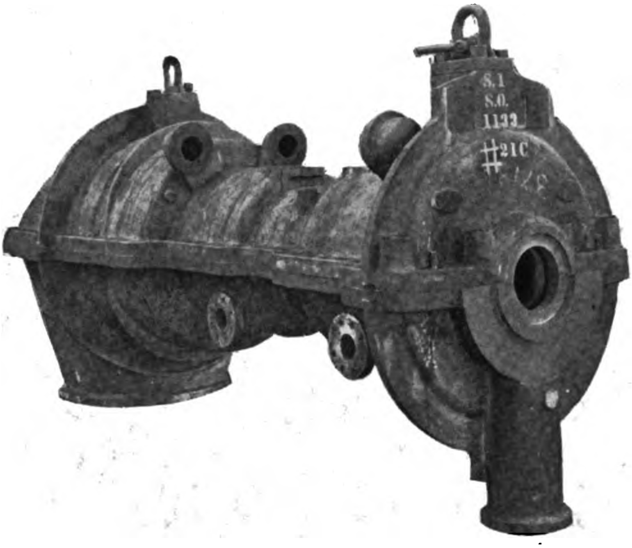


Fig. 4.

Modern rotor constructions are shown in Figs. 1, 2 and 3, giving the high-speed single-flow spindle, the semi-double-flow and the straight double-flow Parsons designs. These views evidence the marked uniformity of section obtaining in the latest high-speed types, enhancing as they do, the mechanical merits of the machines.

Construction: These improvements in the general design of the turbine have kept pace with those of the spindle already noted. In the early machines it is to be recalled that the cylinders were made with rib and web reinforcement and with the equalizer passages and turbine supports cast integral. Material of different thickness at certain parts, and the varying temperatures occurring in the turbine did not encourage the uniformity of cylinder expansion nor facilitate the production of the casting. Such features were mainly accountable for the troubles at first experienced. The early designs were consistently improved until the construction shown in Fig. 4 was developed within the past two years. The excellence of the arrangement is quite obvious in that the cylinder cover and base are entirely symmetrical and unencumbered by external ports. Furthermore, independent supports are provided, permitting the exhaust passage to freely expand and contract without disturbing the alignment. The important features are shown in the assembled machine, Fig. 5,—two 1,000 kw. units at the Dartmouth Manufacturing Company, Dartmouth, Mass.

A tachometer is provided (visible in Fig. 5) which serves as a useful indicator in starting up and shutting down. These machines are equipped with combined automatic throttle and globe valves which present the advantage of insuring that the automatic stop is in good operating condition at all times, as the various valve parts must be capable of performing their respective functions before the machine can be started.

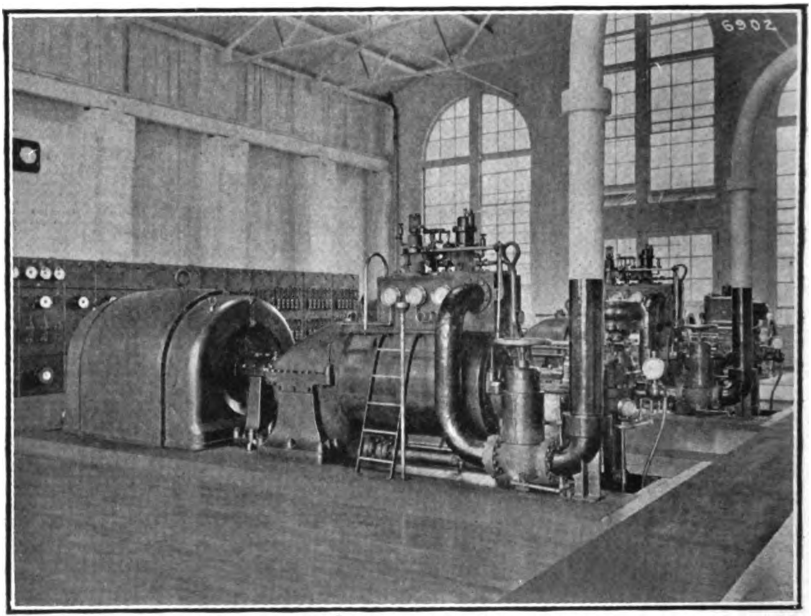


Fig. 5.

The preceding discussion applies to the smaller sizes. When large capacities are encountered, a different problem arises. The size of the exhaust port becomes disproportionately large as compared with the turbine cylinder, necessitating a casting that is difficult to make and naturally a division of the large volume of steam at the low pressure end suggested itself to the designer.

In these large machines the distance between bearings is another item that the designer must contend with in dealing with bending moments and stresses, and it would be impractical to place two reaction machines end to end and divide the flow in opposite directions through the two similar elements. One of the solutions, then, was to substitute for the longest and least efficient section of such a combined machine, a short impulse wheel of about equal efficiency. In doing this, the unit was shortened up over 30% of that of the single-flow design.

Other advantages secured in this arrangement, for large turbines, is the elimination of two of the dummy pistons of the reaction type turbine,—the two low pressure sections equalize their end thrust and the impulse section with all of the expansion taking place in the nozzles, requires no counterbalancing. For the low speeds obtaining in 25-cycle work, the intermediate stage is retained as a single-flow element in order to provide the best blade lengths. A representative section of this type of machine is given in Fig. 6. A feature of interest is the scheme employed to divide the steam between the two equal low pressure stages at opposite ends of the spindle. To pass this large volume of steam through external passages would have required cumbersome ports secured to the cylinder.

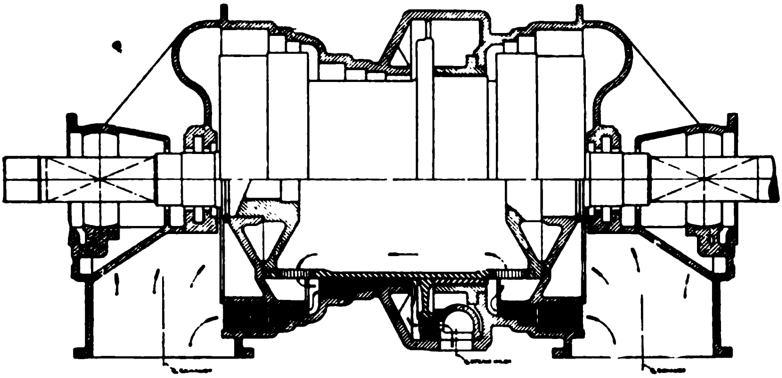


Fig. 6.

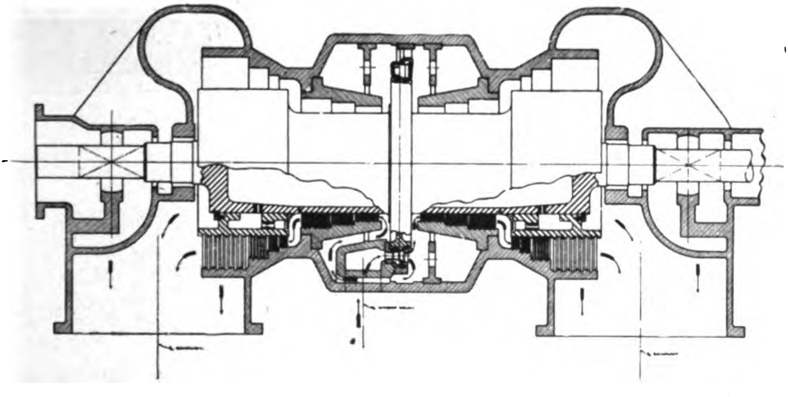


Fig. 7.

This was ingeniously avoided by arranging steam passages in the rotor so that the steam to the low pressure blading would conveniently flow, as indicated by the arrows. As previously indicated, developments in the art have permitted the use of higher rotative speeds and consequently more efficient blading can be proportioned. Therefore, for such speeds as employed in 60-cycle work, a straight double-flow design lends itself admirably. These improvements have resulted in a turbine as shown in section, Fig. 7, which affords an exceptionally symmetrical structure. Furthermore, a decrease in length of the machine has been brought about, together with an additional improvement in economy.

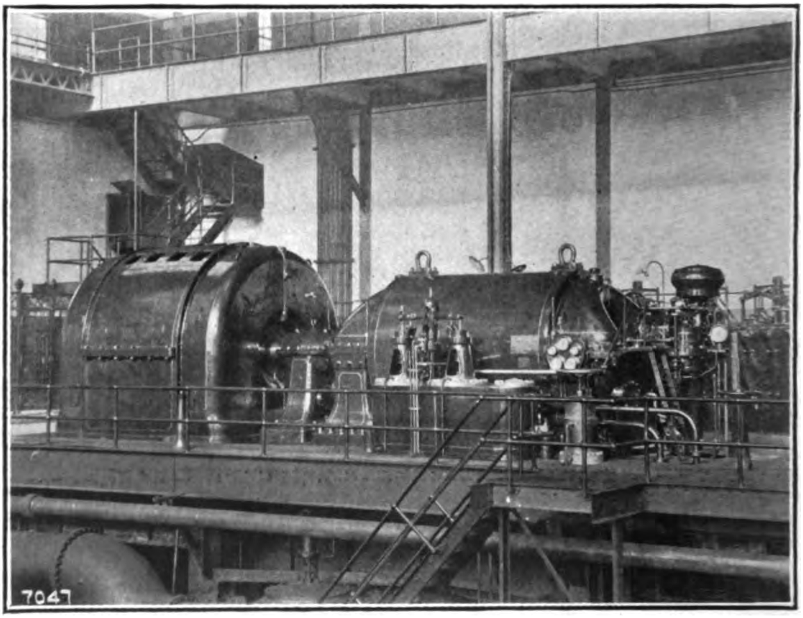
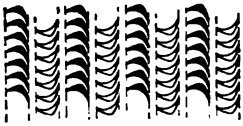


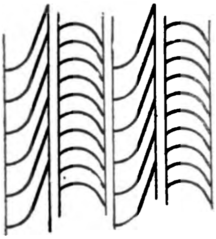
Fig. 8.

In the straight double-flow turbine, the subdivision of steam after it issues from the impulse wheels is very simply accomplished by a short belt around the nozzle blocks. The specific volume of steam, after issuing from the impulse wheel being still relatively small, the subdivision is readily taken care of in this way. An exterior view is presented in Fig. 8.

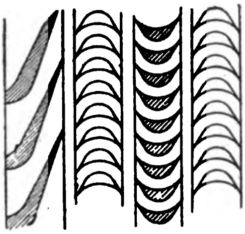
This composite, or hydrid design, was first conceived in this country. It is now rapidly growing to be a leading type here, while abroad it is also gaining favor in a very marked manner. A prediction of its being broadly adopted, is therefore, not amiss. The reasons for this noted trend, are very logical, and chiefly mechanical, as given previously. It proposes, therefore, to retain as much of the reaction blading as may be justified from a constructional standpoint. Experience has fully shown that there is notable difference in efficiency between the nozzle and bucket elements used in terbines. The general results of nozzle and blade experiments indicate that nozzle efficiencies range from 95 to 98%, while single buckets may vary from 70 to 85%. While this salient fact has been insufficiently regarded in the past, it was pertinently considered about two years ago in an engineering paper by Mr. C. H. Smoot before the National Electric Light Association, June, 1908. And the disadvantage of several velocity drops, using a number of buckets in series for absorbing the energy of a large expansion range, was manifested.



Special Parsons Blades



Rateau Buckets and Nozzles



Curtis Buckets and Nozzles

Fig. 9.

Reaction turbines have *specially* constructed *blading formation* which *provides the same results as* nozzles,—expansion taking place in both the rotating and stationary elements. In the impulse type the area of the steam passage through the buckets is sensibly constant. Reaction blades establish varying cross-section in precisely the same manner as obtains in nozzle designs. This feature is illustrated in the upper part of Fig. 9, and is a contributing factor in the high efficiency records attained with the reaction steam turbine. Only when these blades are of relatively short lengths do they become of uneconomical proportion with respect to the leakage annulus, which only evidences itself in the high pressure stage, and therefore the impulse wheel used in this

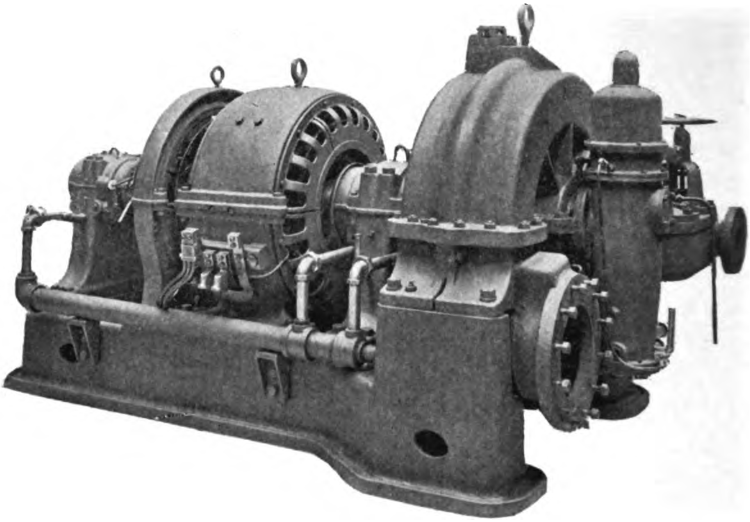


Fig. 10.

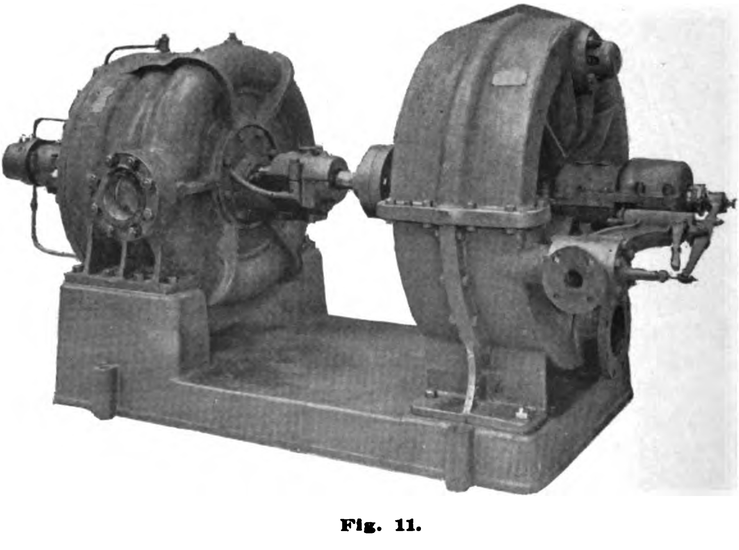


Fig. 11.

part of the turbine does not detract from the efficiency. Moreover, the use of the impulse section utilizing a high pressure and heat drop, removes the wide difference of temperature and pressure with the cylinder which grows in importance with large units.

One will observe directly the difference of the two types of blading which have been placed in the one machine. The impulse buckets are of much heavier section, and this is essentially so for the reason of the higher velocities involved, necessitating a wider face and greater depth of blade. A shroud is demanded to maintain the steam in the blade passage, but in the reaction blading it is neither necessary nor desirable, and this for many reasons, inasmuch as it does not serve a similar function. Owing to the heavier section of the impulse blade, and due to the fact that they usually run at higher speeds, greater provision must be made for safely securing them to the rotor Evidently there exists little if any difference in the mechanical integrity of the two types. In fact, the conservatism is probably greater in the reaction blading. An equal element of safety in operation likewise prevails, as extensive records prove. And this notwithstanding the prejudiced criticisms of the small radial clearances employed. It is to be remembered that such clearance amply allow for all distortion which may bring the spindle and cylinder in contact, and therefore, more liberality in design is unwarranted.

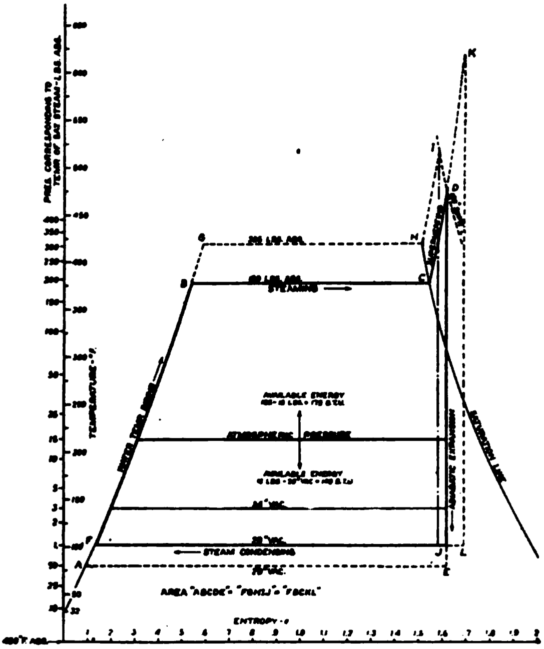


Fig. 12.

Applications: The turbine has been confined entirely to direct

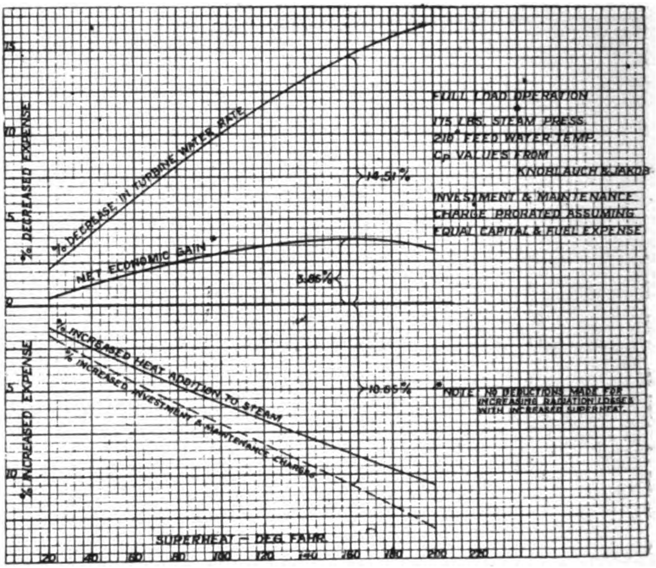
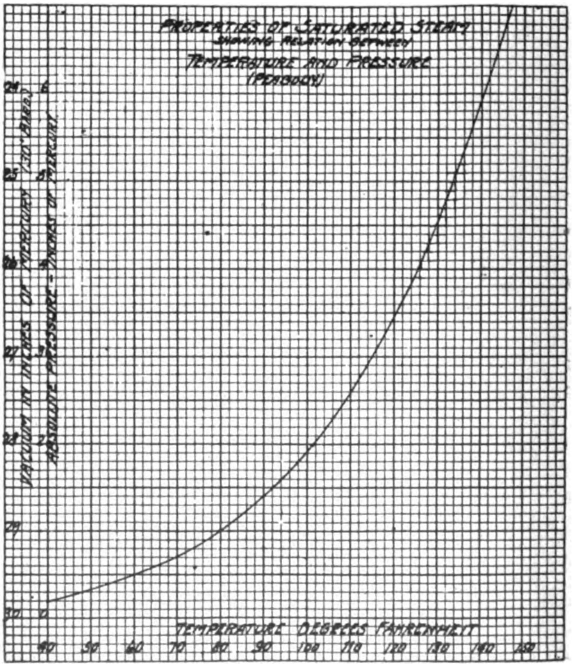


Fig. 13.



TEMPERATURE AND PRESSURE RELATION OF SATURATED STEAM AT LOW PRESSURES

Fig. 14.

driving of generators, but has in recent years, come into favor for boiler feed, exciter and condenser service. The same considerations which have governed the turbines for main units, apply with equal force to exciter sets, Fig. 19, and inasmuch as the installation of steam driven auxiliaries has been found to be most economical in the majority of power plants, this type of machine is obviously being installed with greater frequency. The general compactness of a turbine-driven exciter set is illustrated in one type that has been designed showing an arrangement occupying the minimum of floor space. Similar units have been installed for isolated plants and also for train lighting.

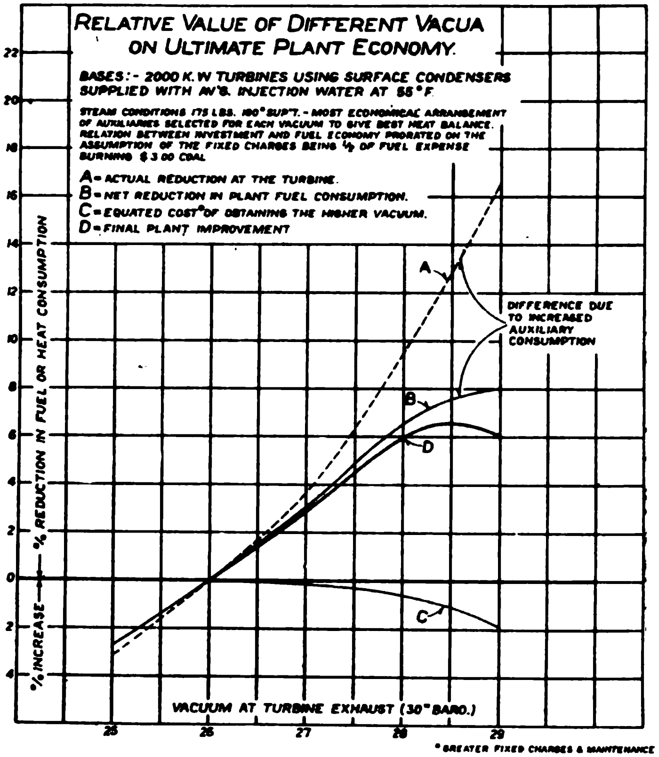


Fig. 15.

In the trend toward the displacement of reciprocating machinery by the rotative type, a unique and important condenser has been devised with auxiliaries of the rotating type which accommodates themselves to turbine drive by virtue of their operating speeds. This type of condenser is manufactured under the Leblanc patents which relate to the removal of air from the condenser body or chamber by sheets of water projected from the air pump runner. This construction possesses many advantages other than the particular point mentioned in this connection; *i. e.*, that it advantageously employs turbine drive. To complete the station equipment with all apparatus turbine-driven, it is only necessary to provide boiler feed pumps of this class. With the better knowledge of the theory of centrifugal pumps, and with more skill in their design, it has become feasible to furnish boiler feeders as shown in Fig. 11, to deliver against 200 to 300 pounds pressure. This boiler feed pump is of the three-stage type, running at 650 r. p. m. and delivering 500 gallons per minute against 200 pounds pressure per square inch. It requires a turbine of 110 h. p. which is designed to operate at 165 pounds boiler pressure and exhaust against atmospheric pressure. It is safe to predict that within a short time the use of the turbine will be further extended by the recent advent of a practical reduction gear, the invention of Melville and Macalpine.* The high speed turbine with this reduction gear has made its entry into marine service, and it is reasonable to expect that it will in the near future be the principal motive power on marine vessels. This particular reduction gear also permits the best selection of turbine and D. C. generator speeds for the most satisfactory performance and best efficiencies in both elements.

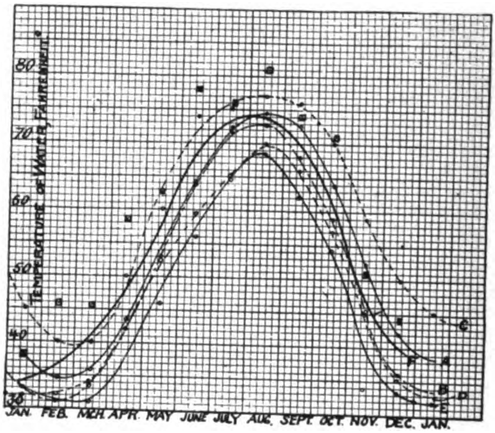


FIG. 11—TEMPERATURE CYCLES FOR THE YEAR AT VARIOUS LOCALITIES

A—Average temperature at 24th Street, East River, New York

B—Average temperature at 57th, Street North River, New York.

C—Maximum temperature at 24th Street, East River, for any one month for three years.

D—Minimum temperature at 24th Street, East River, for any one month for three years.

E—Lake Michigan at 2-Mile Crib, Chicago, 1905. Surface and bottom show no variation.

F—Mean temperature for six years at Horse-Shoe Bay Sandy Hook, N. J.

▣—Maximum temperature for six years at Horse-Shoe Bay.

Fig. 16.

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*See paper by J. A. MacMurchy, Engineers' Society of Penna., September 1910 Proceedings.

No attempt is made to treat herein of the development and utility of the Low Pressure Turbine, which phase in itself is obviously deserving of a lengthy discourse.

Operating Conditions: A striking difference of opinion exists among engineers as to the boiler pressure, superheat and vacuum most suitable for turbine operation. Quite naturally, the wider the limits of the working range of the steam, the lower the water rate of the turbine or engine becomes, due to the greater amount of energy made available in one pound of steam, as illustrated in Fig. 12, a temperature entropy diagram for steam. Obviously in selecting power plant working conditions, it is unwise to strive for the highest efficiencies in the prime mover at a sacrifice in operation of the boiler and condensing apparatus. It is practicable at the present time, to carry pressures as high as 250 pounds gauge, and superheats of 150 degrees and above, as well as to maintain a vacuum as high as 29 inches for the greater part of the time, when the injection water temperature is 65 degrees and below. But the question logically arises, does it pay to resort to these extreme ranges to show the highest possible results in the prime mover. A brief review of the conditions to be reckoned with, will forcibly dictate the use of moderate conditions. For increased pressures, say above 150 pounds, the amount of energy made available is relatively much smaller than at the lower ranges. Furthermore the high boiler pressures require more expensive boilers and piping. 175 pounds gauge works out more suitably for larger units. For smaller machines, the pressure might with propriety be made lower. Superheats of 100 and 150 degrees are entirely feasible with superheater tubes placed in the boiler setting, and up to this point the efficiency is not materially affected by the superheating surface placed in the second pass. It is not advisable to exceed the higher figure, and in fact many engineers prefer not to exceed 100 degrees, and are supported by such convincing facts

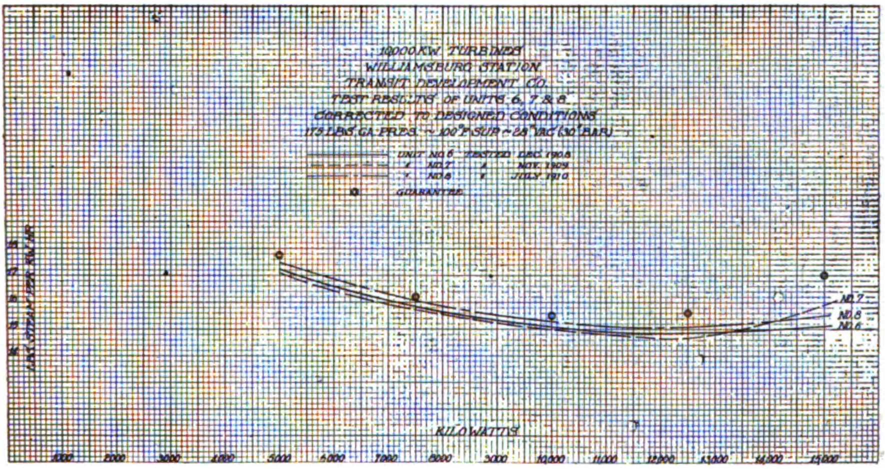

Fig. 17.

as shown in Fig. 14. All assumptions were made to favor high superheat so that in reckoning the deterioration in the system accompanying the higher temperatures, 100 degrees Fahr. may be safely taken as the upper limit. High superheats require the best obtainable grade of pipe fittings, and the maintenance of the superheater and piping are generally greater.

The turbine is inherently efficient in the low pressure ranges, but a fact too frequently lost sight of is the additional cost in power, investment and maintenance to provide for the highest vacuum obtainable. Steam temperatures at the low absolute pressure fall off very rapidly with decreased pressures, as curve in Fig. 13 shows. This consequently limits the temperature rise possible in the injection, and consequently a greater quantity must be handled, involving the expenditure of more power in the auxiliaries. A full appreciation of the point will be gained from Fig. 15. The average vacuum which might be readily produced with efficient condensing apparatus throughout the year, evidently interests the power engineer. In this connection, curves, Fig. 16, are presented to exhibit the varying temperatures occurring throughout the year in different localities. These however, are not the mean for the states, but for certain northern vicinities.

Efficiencies: It is of interest to note how the turbine since its introduction within the past decade, has quickly surpassed the economies established by the most efficient reciprocating engines. This is exhibited by the records of both engine and turbine, Tables III and IV. The best engine economies that have been published, have been obtained by consulting the proceedings of Engineering Societies, and the most important tests are given in Table III. Here we observe that the most efficient engine has shown itself capable of developing a kilowatt hour on about 17 pounds of steam with 175 pounds pressure, 80 to 90 degrees superheat and 28 inches vacuum. This engine record has been improved about 20 per cent. by the turbine—the ability to successfully carry out the expansion of the steam furnishes the explanation. One of the Westinghouse straight double-flow turbines of 10,000 kw. capacity, installed at the City Electric Company, San Francisco, Cal., has, with the same operating conditions, developed a kw. hr. with 13.88 pounds of steam.

Unfortunately, statements are made regarding economy results in which only the actual water rate is given without any reference to the operating conditions. Such unqualified statements regarding steam consumption are meaningless and offer no means of comparison with other records. As no two machines operate under identically the same conditions, we must look for some measure of the performance. The Rankine Cycle, as illustrated in Fig. 17, furnishes an adequate basis which, expressed briefly, is the B. t. u., or energy available between the temperature limits of the steam. The ratio of the B. t. u. actually used by the engine or turbine to the amount theoretically available, is termed the Rankine Cycle efficiency. The engine develops its highest efficiency ratio in the high pressure ranges and the turbine in the low pressure ranges. This accounts for the reason of a combined unit exceeding the best results attained in either type. There are other factors to consider besides the efficiency of the unit, and therefore we do not hear of new stations built along these lines. Substantial improvement can often be made in existing steam engine stations, condensing as well as non-condensing, and the introduction of the low pressure turbine has made remarkable progress within the last few years.

Referring to the operation of complete expansion turbines, the best efficiency results on record are those of a turbine of the double-flow construction, included in a paper recently presented to the American Society of Mechanical Engineers by Samuel Naphtaly;* viz: 69%. While many of the turbines included in Table IV indicate lower water rates, in no case is as excellent an efficiency found. With a better understanding of the economic value of operating conditions as previously amplified with concrete illustrations, it is believed that engineers will cease to give much weight to bare water rates.

Tests: Through the accurate means, and the deliberateness exercised in testing, rapid progress in the turbine industry has been fostered. The effect of certain modifications in the design have therefore, been definitely determined and a way paved for still further improvement.

Many factors enter into the testing of a turbine, and consequently experience and care must necessarily be employed to ensure against errors in observations, which may indicate false results. Obviously an essential consideration is the correct measurement of the turbine output, and with the precision obtaining in electrical science, meters thoroughly calibrated with standards and applied properly, should, of course, introduce no errors. Similar precautions and reliability prevail with the steam measuring apparatus. Moreover, the discovery of the Willans Right line law, as applying to turbines, has proven very beneficial in verifying the accuracy of various test points at different loads. This law establishes the fact that the total steam consumption values for the turbine at various loads lie in a straight line. Hence the law disproves any results that fail to rationalize with other tests that prove to be regular. Besides when the readings are taken completely, the results may also be checked through thermodynamic relations. The neglect of pursuing the practice of verification, has frequently lead to the dissemination of more or less doubtful information.

On the other hand, tests may be conducted with entire certainty.*† As examples, test of a 600 kw. non-condensing turbine made firstly by independent hydraulic brake measurements on turbine, and separate loss method with the generator; these combined, agreed absolutely with the overall tests made afterward on the assembled unit.† And as another instance, two 1,000 kw. turbines for the United States Navy Yards, and authenticated by a Government representative, virtually agreed throughout their entire range of load.† With large turbines tested after installation, the same uniformity of tests apply, as exemplified in tests of three 10,000 kw. turbines at the Brooklyn Rapid Transit Company and given in Fig. 17* Only one point (150% overload) appreciably departs from the values established in other tests, but being the only one out of fifteen load tests, may be regarded lightly inasmuch as it does not conform with the characteristic performance of this design of turbine. At full-load the maximum variation from the mean is somewhat less than 1% in the three different machines, demonstrating emphatically the degree of accuracy obtainable both in the test and construction of the turbine.

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*See A. S. M. E. Proceedings, Dec. 1910, and discussion.

*See discussion "Steam Turbine and Turbo-Generator Testing," A. I. E. E., Dec. 1910 Proceedings.

†See "Steam Turbine Progress," Railway Club of Pittsburg, May 20, 1910.

TABLE IV—(Part I).

Steam Consumption and Efficiencies of Steam Turbines.

Type.	NAME.	Load in kilowatts.	Revolutions per minute.	Boiler pressure lbs. Sq. in Ga.	Superheat degrees F.	Vacuum Ins. of Hg. 30" standard.	Water rate lbs. K. W. Hr.	Rankine cycle efficiency.	Authority.
				American.					
Reaction Westinghouse.	New York Edison, ...	9870	750	177.—	97.—	27.31	15.—	67.3	Operating Co.
	Brooklyn R. T., ...	11466	750	177.—	106.—	28.15	14.45	65.72	Operating Co.
	City Elec. Co., San Francisco, Cal.,	9173	1800	167.—	59.—	27.9	14.57	69.—	J. G. White & Co., Tests.
Impulse Curtis.	New York Edison, ...	8880	......	177.8	108.5	28.1	15.05	63.1	Geo. A. Orrok.
	Commonwealth Edison, ...	10186	750	176.—	147.—	29.47	12.9	62.1	Consulting Engineers.
	Pacific Gas & Elec., ...	8775	750	179.3	72.95	28.03	15.95	61.0	F. H. Varney.

TABLE IV—Continued.

Steam Consumption and Efficiencies of Steam Turbines.

Type.	NAME.	Load in kilowatts.	Revolutions per minute.	Boiler pressure lbs. Sq. in Ga.	Superheat degrees F.	Vacuum Ins. of Hg. 30" standard.	Water rate lbs. K. W. Hr.	Rankine cycle efficiency.	Authority.
				European.					
Reaction.	C. A. Parsons, Carville, ...	5059	1200	194	92	29.27	13.35	62.9	Z. d. V. d. I. 1907—p. 1122.
	C. A. Parsons, Chelsea, ...	6000	1000	190	140	28.00	14.09	65.8	Test Results.
	Brown-Boveri, Frankfurt, ...	3522	1360	142	136	28.92	13.68	65.8	Z. d. V. d. I. 1908—p. 516.
Impulse.	Escher Wyss Co., Essen, ...	5118	1025	146	158	27.63	15.16	65.1	Z. d. V. d. I. 1908—p. 1436.
	Escher Wyss Co., Turin, ...	3540	1485	172	105	28.29	15.10	64.4	Z. d. V. d. I. 1908—p. 1437.
	A. E. G. Moabit-Berlin, ...	3169	1500	170	217	29.19	12.74	63.5	Z. d. V. d. I. 1907—p. 386.
	A. E. G. Rummelsburg, ...	4239	1497	173	285	29.19	11.90	65.1	Z. d. V. d. I. 1909—p. 762.
	D. Howden & Co., Manchester, ...	7520	1000	184	133	27.55	14.50	67.0	The London Engineer 1909—p. 462.
	D. Howden & Co., Manchester, ...	6383	1000	188	137	27.44	14.30	67.6	The London Engineer 1909—p. 462.

Peabody's Steam Tables, 1909, Edition, used in calculating Rankine cycle eff. on K. W. Hr. basis.
Z. d. V. d. I.—Proceedings of the German Society of Engineers.

PUBLISHED TESTS—RECIPROCATING ENGINES.

Name of Engine,	McIntosh Seymour & Co.								Westinghouse.				Allis-Chalmers.				Allis-Chalmers.				
Station,	Boston Edison and Cambridge.								N. Y. Edison.				Interboro.				Manhattan.				
Nominal Elec. Load,	½k	¾k	½c	¾c	1k	1c	1c	1c	.....	¾	1	1	.....	.....	.....	1	.....	.....	.....	1	....
Nominal H. P. Cyl. Diam. inches,	81	81	29	29	81	29	29	.....	.....	44	44	44	.....	.....	.....	42	.....	.....	.....	.....	....
Nominal L. P. Cyl. Diam. inches,	64	64	60	60	64	60	60	.....	.....	76	76	76	.....	.....	.....	86	.....	.....	.....	.....	....
Stroke, inches,	48	48	56	56	48	56	56	.....	.....	60	60	60	.....	.....	.....	60	.....	.....	.....	.....	....
Steam Pres. at Throt. (ga),	136	132	169.4	167	136	1686	1628	.....	.....	185.6	188.1	185.6	.....	.....	.....	175.18	.....	.....	.....	175	....
Superheat at Throt.,	55.8	70.3	48.3	64.5	64.2	80.2	98.4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
Vac. and Exh., No. 2,	26.4	26.4	26.1	25.6	25.4	24.9	25.6	.....	.....	26.9	26.36	27.25	.....	.....	.....	25.52	.....	.....	.....	27.5	....
I. H. P.,	716	1196	1239	1831	2184	2267	2202	.....	.....	4230	5278	.....	.....	.....	.....	7365	.....	.....	.....	6000	....
Total Steam per I. H. P.,	12.95	12.22	12.38	12.71	12.50	12.72	11.57	.....	.....	12.45	12158	.....	.....	.....	.....	11.96	.....	.....	.....	.....	....
Mech. Efficiency,	.....	.....	.....	86	.....	90	.....	.....	.....	94.7	.....	95	.....	.....	.....	92.5	.....	.....	.....	22.5	cyl. work
Generator Efficiency,	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
Steam per kwh.,	.....	.....	.....	19.88	18.62	18.95	17.23	.....	.....	17.7	17.1	16.78	.....	.....	.....	17.84	.....	.....	.....	17.41	equal
																	.....	.....	.....	17.08	unequal
Authority,	Prof. Lionel S. Marks.								J. D. Andrew.				A. C. Co.				H. G. Stott.				
Date,	A. S. M. E. Transactions, 1904.								N. E. L. A. Proceedings, 1904.				Bulletin.				A. I. E. E. Proceedings.				

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GOOD ROADS

Announcement by the Editorial Staff.

The proper construction of highways is an engineering accomplishment. The consensus of opinion among many engineers in Pennsylvania was ascertained to be in favor of manifesting the interest which the profession takes in the matter by the selection of an appointed time for a gathering where a thorough review of the entire subject could be had, where papers by acknowledged experts would be presented and discussed. The proposition finally took shape in the form of a good roads meeting held in the House of Representatives on the evening of March 7th, 1911, under the auspices of the Engineering Society of Pennsylvania, in co-operation with the Legislative Committee on Highways, Hon. William C. Sproul, Chairman Senate Committee on Highways, and Hon. Edward E. Jones, Chairman House Committee on Highways.

Mr. Logan Waller Page, Director, Office of Public Roads, U. S. Department of Agriculture, spoke on "The Organization of a State Highway Department" and "The Road Situation in Pennsylvania," given in another place.

Mr. Walter B. Thomson, Division Engineer and Highway Representative of the Pennsylvania Railroad Company, spoke on "What Good Roads Mean to Railroads" and "The Economical Maintenance of Dirt Roads," given in another place.

Hon. Frank D. Lyon, Deputy Commissioner of Highways of New York, spoke on "Beginning of the Good Roads Movement."

Prof. John Price Jackson, Dean of the College of Engineering, State College, in charge of "The Good Roads Train," spoke on the subject of "The Good Roads Train."

In opening the meeting, Mr. David Tracy, President of the Society, said:

"As President of the Engineering Society of Pennsylvania, it is my pleasure to preside over this meeting called for the discussion of a subject of vital importance to the State of Pennsylvania. It is naturally of interest to engineers as the construction and maintenance of good roads will require proportionately as much engineering skill as the development of our railroad systems.

"The State of Pennsylvania is boastful, and justly so, of its great agricul tural and mineral wealth and of its grand system of railways; but it is sadly lacking in proper highways along which the products of its soil can be conveyed to the cities and railways. This condition is in no manner the fault of our present Highway Department. With inadequate funds and inadequate laws, they have been enabled to only make small patches of good roads here and there through the State. I trust that our present legislative members will favor the enactment of a good roads law which will enable the Highway Department to perform the work of which it is capable."

Hon. Edward E. Jones, on behalf of Senator Sproul, expressed regret for the Senator's absence, owing to a prior engagement. He referred to the Senator as author of the bill known as the Sproul Bill, which is occupying at the present time a large share of attention in the Legislature and is being talked about all over the State of Pennsylvania. Years ago he first introduced the Sproul-Roberts Act which was the beginning of better roads in Pennsylvania. From that time on the Senator had always been identified with all the movements that made for better roads in the Commonwealth.

Speaking for himself, Mr. Jones said that the utmost desire of his as a Legislator is to be instrumental in bringing about the betterment of the roads of Pennsylvania and he was pleased to note the movement among members of the Engineers Society of Pennsylvania to further the interests of good roads. He said the committee of which he is chairman, has profited by advice afforded by engineers experienced in road building and in the administration of laws regulating and controlling highway construction and maintenance.

The Lecture Committee of the Society, who arranged the program, naturally sought the seat of our National Government at Washington for a speaker who had given the subject careful study from the broadest possible view point. Mr. Page, among other things, said:

I was asked here to-night to discuss the matter of State aid legislation. This is a subject that has occupied the time of a very large number of State Legislatures since 1892. You remember that the advent of the railroads in this country rather called the attention of the public from the construction and maintenance of the public highways, and a great many believed at that time that there would be little or no use for the public highway, and our roads rapidly fell into decay, those that had been built. You have heard of the old National Turnpike, the old Cumberland Road, built at an expense of about six million dollars by the Federal Government. The Government turned it over to the States, the States turned it over to the Counties and, finally, it remains as we see it to-day, practically no better than any other county turnpike.

I have been looking over the bills that have been presented to the Legislature, one known as Senate Bill 103, of which I wish particularly to discuss a few points. First, this bill calls for a State Highway Commissioner for a term of four years at a salary of eight thousand dollars; two Deputy Commissioners, one at a salary of six thousand dollars and one at a salary of five thousand dollars. One of those Deputy Commissioners must be a Civil Engineer. Then they appoint, with the consent of the Governor, a Chief Engineer at a salary of four thousand dollars a year. Being a Highway Engineer myself, I must say that these figures sound very peculiar to me. Why should a lawyer, or doctor, or politician, or anybody that has never studied the subject of highway engineering be given a salary of eight thousand dollars, when the engineer who is responsible for the work, who sees it all through, plans it, gets only half that amount?

Then there are six engineers as assistants to the Chief Engineer at two thousand four hundred dollars each, and a chief draftsman and fifty superintendents of construction.

The point I wish to raise here is this: The present law of Pennsylvania provides for a Highway Commissioner for the term of four years at a salary of six thousand five hundred dollars, and a Deputy Commissioner. Now, why should we create, as this bill creates, a brand new department founded exactly on the same lines as the old bill, and doing away with the old bill? It would require the best Highway Engineer, who is thoroughly conversant with all the problems of Highway Engineering, it would require him four or five years to come into a State like Pennsylvania, and familiarize himself with the various problems involved in the improvement of the highways. Pennsylvania has such a man, who has spent eight years conducting the Highway Department of the State, and why should this old department be wiped out simply for the purpose of putting in another one which is a duplicate of it, but a great deal more expensive. I am speaking now only of the administrative side of the work. If the State, if the Legislature, has determined to do away with the present Highway Department, why they certainly ought to introduce some measure that would be an improvement on it. There is just in one respect that comes to my mind that it could be improved on, and the lessons that we have learned in the various States that have adopted State aid is that the greatest interference with highway work is politics. Now, in most of the States there are State Highway Commissions of three, and they are appointed by the Governor. The result is, since there are no requirements that they shall be highway engineers, or conversant with the problems of highway engineering, it has come about that new men are put in every few years, and in some instances a great many interfere materially with the engineering work of the commission. I know of several very pointed cases where men who are simply politicians are put in this important position, and naturally, drawing large salaries, they want to make themselves as conspicuous as possible in the work, and they are continually traveling about on that work interfering with the engineers on that work. There is but one way that I know of that State Highway Departments can be absolutely removed from politics, and that is, if we take Pennsylvania for example, if a member of the engineering faculty of the University of Pennsylvania, and a member of the engineering faculty of the Pennsylvania State College, were made *ex-officio* non-paid members of the Highway Commission, and the Governor allowed to appoint a third member, and this Commission were allowed to appoint a Chief Engineer, and he should serve the Commission as long as his services were satisfactory to them, and he appoint his subordinates with the consent of the Commission, I do not see how politics could very well interfere with it. This is not a visionary scheme. It has already been adopted in two States, and in one of them where it has been operative longest there has not been a complaint in four years of its operation against that Commission that I have ever heard of. The Commission only meets three or four times a year. They meet and have the Attorney General of the State meet with them, see that the State Highway

Engineer is properly carrying out the provisions of the law; they have his accounts carefully audited, and there is nothing more for the Commission to do. And there are many—you will find that the members of the engineering faculty of state colleges are only too glad to serve for the honor attached to the position.

The relation between good roads and the great railway system in Pennsylvania has not been prominently brought out and the Lecture Committee sought a Pennsylvania Railroad highway expert to talk about this matter. Mr. Thomson's address is given in full elsewhere.

A number of the legislators expressed a desire to learn how a neighboring State handles the matter of good roads and so the committee secured the Deputy Commissioner of Highways of New York State to describe the system in vogue in that State. Mr. Lyon's remarks are given in full elsewhere and so are those of Prof. Jackson.

The Sproul Bill is as follows:

An act providing for the establishment of a State Highway Department by the appointment of a State Highway Commissioner, two Deputy State Highway Commissioners, chief engineer, chief draughtsman, superintendents of highways and a staff of assistants and employes, defining their duties and the jurisdiction of the State Highway Department and fixing salaries of commissioner and deputies and of other appointees, providing for taking over upon the passage of this act from the counties or townships of the Commonwealth certain existing public roads connecting county seats and extending to the State line. Describing and defining same by route numbers as the State highways of the Commonwealth. Providing for the improvement, maintenance and repair of said State highways solely at the expense of the Commonwealth and relieving the several townships or counties from any further obligation and expense to improve or maintain the same and relieving said townships or counties of authority over same, requiring the State Highway Commissioner to make maps to be complete records thereof. Providing for the payment of damages in taking of property or otherwise in the improvement thereof. Providing for purchase or acquiring of turnpikes or tollroads forming all or part of any State highway and procedure therein. Providing for work of improvement of State Highways to be done by contract except where the State Highway Commissioner decides the work be done by the State. Providing aid by the State to counties and townships desiring the same in the improvement of township or county roads. Defining highways and State-aid highways. Providing method of application for State-aid in the improvement, maintenance and repair of township or county roads and prescribing the contents of township, county or borough petitions. Providing for percentage of cost of improvement or repairs to be paid by State, county or township or borough and requiring contracts by counties, townships and boroughs with Commonwealth governing same. Providing for the minimum width of State highways and State-aid highways and kind of materials to be used in the improvement. Providing for payment of cost of improvement and repairs. Providing penalty for injuring or destroying State highways. Making appropriations to carry out the provisions of the act and providing for the repeal of certain acts relating to Highway Department and improvement of roads and of all acts or parts of acts inconsistent herewith and providing that existing contracts are not affected by provisions of this act.

Section 1. Be it enacted by the Senate and House of Representatives of the Commonwealth of Pennsylvania in General Assembly met, and it is hereby enacted by the authority of the same. That immediately upon the approval of this act, a State Highway Department be established by the appointment by the Governor of the Commonwealth with the advice and consent of the Senate, for a term of four years, of a State Highway Commissioner, who shall give his entire time and attention to the duties of his said office. He shall be paid a salary at the rate of eight thousand dollars per annum and in addition shall be allowed actual traveling expenses incurred in the performance of the duties of his office. Before entering upon the duties of his said office he shall furnish a bond to the Commonwealth in the sum of twenty-five thousand dollars to be approved by the Governor, conditioned for the faithful performance of his duties. The Highway Commissioner may appoint with the approval of the Governor, as the work of department requires, two Deputy State Highway Commissioners, to be known as first Deputy State Highway Commissioner and second Deputy State Highway Commissioner, one of whom shall be a competent civil engineer experienced in the construction and maintenance of improved roads. The first Deputy State Highway Commissioner shall be paid a salary at the rate of six thousand dollars per annum and the second Deputy State Highway Commissioner shall be paid a salary at the rate of five thousand dollars per annum. Each deputy shall be allowed in addition to salary actual traveling expenses when incurred in the performance of official duties. Before taking office each shall give bond to the Commonwealth to be approved by the Governor in the sum of fifteen thousand dollars conditioned for the faithful performance of his said duties. They shall be subject at all times to the authority of the State Highway Commissioner and shall perform such duties and such service as shall be required of them by him and in the absence of the State Highway Commissioner shall, in the order of their precedence to each other, perform and discharge all the duties of the State Highway Commissioner as required by law and the provisions of this act.

Section 2. The State Highway Commissioner shall appoint a chief engineer of the Department, who shall be a capable and competent civil engineer and experienced in the building and maintenance of improved roads, who shall be paid a salary at the rate of four thousand dollars per annum and shall be allowed in addition thereto his actual traveling expenses incurred when on official business of the Department. He shall also appoint as an assistant to the chief engineer an engineer of bridges, who shall be a capable and competent civil engineer experienced in the designing and construction of bridges, who shall be paid a salary at the rate of thirty-six hundred dollars per annum and shall be allowed in addition thereto his actual traveling expenses incurred when on official business of the Department. He shall also appoint fifty competent civil engineers, experienced in the construction and maintenance of improved roads, who shall be known as superintendents of highways, each of whom shall be paid a salary at the rate of fifteen hundred dollars per annum and in addition therto shall be allowed actual traveling expenses incurred in or concerning the performance of their official duties. He may also appoint, when and as the work of the Department requires, six competent civil engineers experienced in improved road building to act as assistants to the chief engineer and who shall each be paid a salary at the rate of twenty-four hundred dollars per annum and in addition thereto shall be allowed their actual traveling expenses when on official business. He shall also appoint a chief draughtsman, who shall also be an experienced civil engineer and who shall be paid a salary at the rate of twenty-four hundred dollars per annum. He may also appoint eight assistant draughtsmen, who shall also be civil engineers who shall be paid a salary at the rate of eighteen hundred dollars per annum. He shall also appoint a chief clerk who shall be paid a salary at the rate of twenty-four hundred dollars per annum and may employ two competent additional clerks and two competent stenographers each at a salary at the rate of twelve hundred dollars per annum, and in addition thereto may appoint and employ from time to time such additional stenographers and clerks as the work of the Department requires, which additional appointees or employes shall each be paid a salary not to exceed one thousand dollars per annum. He may also appoint two competent bookkeepers, who shall each be paid a salary at the rate of twelve hundred dollars per annum. The State Highway Commissioner shall assign the superintendents of highways to such sections or parts of the State as in the judgment of said Commissioner will enable said superintendents to render most efficient service in the improvement of the highways. It shall be the duty of each superintendent of highways subject to the authority of the Commissioner and in accord with the rules and regulations of the Department to superintend, supervise, preside over, take charge and control of all work of construction, building, rebuilding, maintenance and repair of the State-aid and State highways or any portions thereof in his said district or placed in his charge, and it shall be the further duty of each superintendent of highways to instruct the authorities having charge of the highways in the counties or townships in his district which receive aid from the State in the maintenance of highways and as to the methods to be employed at all times in the construction, maintenance and repair of culverts or bridges in the said counties or townships.

Section 3. The State Highway Commissioner is hereby empowered to make and adopt rules and regulations for conducting the business and work of the department not otherwise expressly provided in this act, and to prescribe the duties of all appointees and employes. All appointees or employes of the department shall be subject to removal or discharge by the State Highway Commissioner.

He is hereby authorized and empowered to purchase all machinery, implements, tools and materials of any and every kind incident to or necessary in the construction, building, rebuilding and maintenance of the state highways hereinafter described, including the right to employ all necessary labor, and he may also employ convict labor, and if in the judgment of the commissioner it is necessary in order to expedite and more efficiently carry out the work of the department, he may purchase and maintain at the expense of the department wagons and other vehicles, including horses, mules and harness, and provide for their keeping and maintenance, which shall be used only in connection with the work of the department.

Section 4. The State Highway Department shall be provided with suitable rooms in the State building at Harrisburg and its offices shall be open at all reasonable times for the transaction of public business. The State Highway Commissioner shall carry into effect the provisions of this act and all other acts of Assembly providing for the operation and co-operation of the State in the construction and maintenance of State and public highways. He shall have charge of the records of the State Highway Department and shall each year submit to the Governor of the Commonwealth a full report of the operations of the department a report of materials, cost and character of roads built, rebuilt or maintained under its direction, detailed statements of the expense of the department and such other information concerning the condition of the public roads of the State and particularly of the State-aid and state highways and the progress of their improvements as may be proper or required.

Section 5. Anything herein contained or any apportionment of the state into highway districts shall not be construed as including or in any manner interfering with the roads, streets and highways of any of the cities or boroughs of the Commonwealth. Provided, Where any street or highway within the limits of any borough shall form a part or section of any state highway as herein described the State Highway Commissioner by and with the consent of the borough councils may improve and repair such section of highway and maintain the same thereafter at the sole expense of the Commonwealth.

Section 6. All highways designated in this act as state highways are hereby taken over from the several counties or townships of the state and shall be constructed, improved and maintained by the State Highway Commissioner solely at the expense of the Commonwealth and the work of construction, building, rebuilding and the maintenance and repair thereof shall be commenced and carried on by the State Highway Commissioner on all of the state highways as equally and uniformly as circumstances and conditions will permit. The total expense of the construction, improvement or maintenance of State Highways under the provisions of this act shall be paid by the State Treasurer upon the warrant of the State Highway Commissioner, attested by the chief clerk of the State Highway Department, out of any appropriation or appropriations made by the Legislature to carry out the provisions of this act. Provided, That from and after the passage of this act the several townships and counties of the State through which all or any portion or portions of said State highways as hereinafter designated may pass are relieved of any further obligation or expense to construct, maintain or repair same and shall no longer have any control over any part thereof.

Section 7. From and after the adoption of this act all those certain existing public roads, highways, turnpikes and tollroads, or any parts or portions thereof subject to the provisions hereinafter made in the case of turnpikes and tollroads forming and being main traveled roads or routes between the county seats of the several counties of the Commonwealth and main traveled roads or routes leading from the county seat of State border-line counties to the State line shall hereafter be known, marked, built, rebuilt, constructed, repaired and maintained by and at the sole expense of the Commonwealth and shall be under the exclusive authority and jurisdiction of the State Highway Department, and shall constitute a system of State highways, the same being more particularly described and defined as follows:

Route 1, from Harrisburg to Sunbury. * * * Route 2, from Sunbury to Danville. * * * Route 3, from Danville to Bloomsburg. * * * Route 4, from Bloomsburg to Wilkes-Barre. * * * Route 5, from Wilkes-Barre to Scranton. * * * Route 6, from Scranton to Honesdale. * * * Route 7, from Honesdale to Milford. * * * Route 8, from Milford to Matamoras. * * * Route 9, from Scranton to Montrose. * * * Route 10, from Montrose to New York State line. * * Route 11, from Wilkes-Barre to Tunkhannock.* * * Route 12, from Tunkhannock to Montrose. * * * Route 13, from Tunkhannock to Towanda. * * * Route 14, from Towanda to New York State line. * * * Route 15, from Towanda to Montrose. * * * Route 16, from Bloomsburg to Laporte. * * * Route 17, from Laporte to Towanda. * * * Route 18, from Sunbury to Williamsport. * * * Route 19, from Williamsport to Laporte. * * * Route 20, from Williamsport to Towanda. * * * Route 21, from Williamsport to Wellsboro. * * * Route 22, from Wellsboro to New York State line. * * * Route 23, from Williamsport to Lock Haven. * * * Route 24, from Lewisburg to Sunbury. * * * Route 25, from Sunbury to Middleburg. * * * Route 26, from Middleburg to Lewisburg. * * Route 27, from Lewisburg to Bellefonte. * * * Route 28, from Middleburg to Lewistown. * * * Route 29, from Lewistown to Bellefonte. * * * Route 30, from Harrisburg to New Bloomfield. * * Route 31, from New Bloomfield to Mifflintown. * * * Route 32, from Mifflintown to Lewistown. * * * Route 33, from Lewistown to Huntingdon. * * * Route 34, from Harrisburg to Carlisle. * * * Route 35, from Carlisle to Chambersburg. * * * Route 36, from Chambersburg to the Maryland State line. * * * Route 37, from Chambersburg to McConnellsburg. * * * Route 38, from McConnellsburg to the Maryland State line. * * * Route 39, from McConnellsburg to Bedford. * * * Route 40, from Carlisle to New Bloomfield. * * * Route 41, from Carlisle to Gettysburg. * * * Route 42, from Gettysburg to the Maryland State line. * * * Route 43, from Gettysburg to Chambersburg. * * * Route 44, from Gettysburg to the Maryland State line. * * * Route 45, from Chambersburg to Mifflintown. * * * Route 46, from Bedford to Huntingdon. * * * Route 47, from Bedford to Hollidaysburg. * * * Route 48, from Bedford to the Maryland State line. * * * Route 49, from Bedford to Somerset. * * * Route 50, from Somerset to Uniontown. * * * Route 51, from Somerset to the Maryland State line. * * * Route 52, from Somerset to Ebensburg. * * * Route 53, from Ebensburg to Hollidaysburg. * * * Ruote 54, from Ebensburg to Indiana. * * * Route 55, from Huntingdon to Hollidaysburg. * * * Route 56, from Huntingdon to Belefonte. * * * Route 57, from Hollidaysburg to Clearfield. * * * Route 58, from Bellefonte to Lock Haven. * * * Route 59, from Clearfield to Ridgeway. * * * Route 60, from Clearfield to Brookville. * * * Route 61, from Ridgeway to Brookville. * * * Route 62, from Ebensburg to Clearfield. * * * Route 63, from Indiana to Brookville. * * * Route 64, from Brookville to Clarion. * * * Route 65, from Clarion to Franklin. * * * Route 66, from Clarion to Kittanning. * * * Route 67, from Indiana to Kittanning. * * * Route 68, from Indiana to Greensburg. * * * Route 69, from Greensburg to Kittanning. * * * Route 70, from Pittbsurg to Kittanning. * * * Route 71, from Kittanning to Butler. * * * Route 72, from Pittsburg to Butler. * * * Route 73, from Butler to Mercer. * * * Route 74, from Mercer to the Ohio State line. * * * Route 75, from Butler to Franklin. * * * Route 76, from Pittsburg to Beaver. * * * Route 77, from Beaver to New Castle. * * * Route 78, from Beaver to Butler. * * * Route 79, from Butler to New Castle. * * * Route 80, from New Castle to Mercer. * * * Route 81, from New Castle to the Ohio State line. * * * Route 82, from Mercer to Meadville. * * * Route 83, from Meadville to the Ohio State line. * * * Route 84, from Meadville to Erie. * * * Route 85, from Meadville to the Ohio State line. * * * Route 86, from Erie to the Ohio State line. * * * Route 87, from Erie to the New York State line. * * * Route 88, from Erie to Warren. * * * Route 89, from Meadville to Warren. * * * Route 90, from Meadville to Franklin. * * * Route 91, from Franklin to Tionesta. * * * Route 92, from Clarion to Tionesta. * * * Route 93, from Tionesta to Warren. * * * Route 94, from Warren to the New York State line. * * * Route 95, from Warren to Smethport. * * * Route 96, from Smethport to the New York State line. * * * Route 97, from Smethport to Ridgway. * * * Route 98, from Tionesta to Ridgway. * * * Route 99, from Ridgway to Emporium. * * * Route 100, from Emporium to Smethport. * * * Route 101, from Smethport to Coudersport. * * * Route 102, from Coudersport to Wellsboro. * * * Route 103, from Coudersport to the New York State line. * * * Route 104, from Coudersport to Emporium. * * * Route 105, from Emporium to Lock Haven. * * * Route 106, from Wellsboro to Lock Haven. * * * Route 107, from Bellefonte to Clearfield. * * * Route 108, from Pittsburg to Washington. * * * Route 109, from Washington to Waynesburg. * * * Route 110, from Waynesburg to the West Virginia State line. * * * Route 111, from Waynesburg to the West Virginia State line. * * * Route 112, from Waynesburg to Uniontown. * * * Route 113, from Uniontown to Washington. * * * Route 114, from Washington to the West Virginia State line. * * * Route 115, from Washington to Beaver. * * * Route 116, from Uniontown to the West Virginia State line. * * * Route 117, from Uniontown to Greensburg. * * * Route 118, from Greensburg to Washington. * * * Route 119, from Bedford to Greensburg. * * * Route 120, commencing in Greensburg and running * * * to a point on the boundary line of the City of Pittsburg, Allegheny county. * * * Route 121, from Chambersburg to Huntingdon. * * * Route 122, from Chambersburg to New Bloomfield. * * * Route 123, from Harrisburg to Gettysburg. * * * Route 124, from Harrisburg to York. * * * Route 125, from Carlisle to York. * * * Route 126, from Gettysburg to York. * * * Route 127, from York to the Maryland State line. * * * Route 128, from York to Lancaster. * * * Route 129, from Harrisburg to Lancaster. * * * Route 130, from Philadelphia to Media. * * * Route 131, from Philadelphia to the Maryland State line. * * * Route 132, from Media to the Delaware State line. * * * Route 133, from Philadelphia to West Chester. * * * Route 134, from West Chester to the Maryland State line. * * * Route 135, from West Chester to the Delaware State line. * * * Route 136, from Lancaster to the Maryland State line. * * * Route 137, from West Chester to Lebanon. * * * Route 138, from Lebanon to Lancaster. * * * Route 139, from Harrisburg to Lebanon. * * * Route 140, from Harrisburg to Pottsville. * * * Route 141, from Lebanon to Pottsville. * * * Route 142, from Lancaster to Philadelphia. * * * Route 143, from West Chester to Norristown. * * * Route 144, from Media to Norristown. * * * Route 145, from Philadelphia to Norristown. * * * Route 146, from Norristown to Reading. * * * Route 147, from West Chester to Reading. * * * Route 148, from Lancaster to Reading. * * * Route 149, from Lebanon to Reading. * * * Route 150, from Philadelphia to Morrisville. * * * Route 151, from Philadelphia to Doylestown. * * * Route 152, from Doylestown to the New Jersey State line. * * * Route 153, from Philadelphia to

Allentown. * * * Route 154, from Allentown to Doylestown. * * * Route 155, from Doylestown to the New Jersey State line. * * * Route 156, from Doylestown to Easton. * * * Route 157, from Reading to Allentown. * * * Route 158, from Norristown to Allentown. * * * Route 159, from Allentown to Easton. * * * Route 160, from Reading to Pottsville. * * * Route 161, from Pottsville to Sunbury. * * * Route 162, from Pottsville to Mauch Chunk. * * * Route 163, from Allentown to Mauch Chunk. * * * Route 164, from Mauch Chunk to Stroudsburg. * * * Route 165, from Easton to Stroudsburg. * * * Route 166, from Easton to the New Jersey State line. * * * Route 167, from Stroudsburg to Milford. * * * Route 168, from Stroudsburg to Scranton. * * * Route 169, from Stroudsburg to Wilkes-Barre. * * * Route 170, from Mauch Chunk to Wilkes-Barre. * * * Route 171, from Stroudsburg to Honesdale. Route 172, from Scranton to Honesdale. * * * Route 173, from Honesdale to the New York State line. * * * Route 174, from Honesdale to Montrose. * * * Route 175, from Easton to Mauch Chunk. * * * Route 176, from Lewisburg to Williamsport. * * * Route 177, from Wilkes-Barre to Laporte. * * * Route 178, from Doylestown to Norristown. * * * Route 179, from Media to West Chester. * * * Route 180, from Philadelphia to the Delaware State line. * * * Route 181, from Washington to Greensburg. * * * Route 182, from Danville to Pottsville. * * * Route 183, from Bloomsburg to Pottsville. * * * Route 184, from Bloomsburg to Mauch Chunk. * * * Route 185, from Pottsville to Wilkes-Barre. * * * Route 186, from Somerset to Pittsburg. * * * Route 187, from Pittsburg to Indiana. * * * Route 188, from Indiana to Pittsburg. * * * Route 189, from Kittanning to Clearfield. * * * Route 190, from Harrisburg to the Maryland State line. * * * Route 191, from Bloomsfield to Chambersburg. * * * Route 192, from McConnellsburg to Huntingdon. * * * Route 193, from McConnellsburg to Mifflintown. * * * Route 194, from Miffintown to Middleburg. * * * Route 195, from Harrisburg to Middleburg. * * * Route 196, from Wellsboro to the New York State line. * * * Route 197, from Philadelphia to Reading. * * * Route 198, from Allentown to Philadelphia. * * * Route 199, from Harrisburg to Pottsville. * * * Route 200, from Meadville to Warren. * * * Route 201, from Philadelphia to Reading. * * * Route 202, from Allentown to West Chester. * * * Route 203, from Kittanning to Greensburg.

And the State Highway Commissioner shall at once prepare and file for public use in the department maps of the State highways therein defined and described which shall show detailed descriptions thereof, including cross roads, towns, villages and other important points or places and upon construction or reconstruction or said State highways the Commissioner shall cause to be placed upon said maps all data and information as to grades, bridges, culverts, nature of surface, character and kind of construction, together with the cost thereof per mile, and he shall from time to time add thereto and thereon such additional data and information as shall be necessary to make said plans at all times a complete record of said State highways. Provided, That where the description of any route herein given may state the beginning or termination, or intermediate points of the route to be at an indefinite or unidentified point or place, or at or upon an unnamed road or street, the same shall be definitely identified and determined by the State Highway Commissioner.

Section 8. Whenever, in the construction, reconstruction, maintenance and repair of any of the said State highways, it shall appear to the Commissioner that any part or portion of a State highway as now defined and described in this act is dangerous or inconvenient to the traveling public in its present location either by reason of grades, dangerous turns or other local conditions, or that the expense to the Commonwealth in the construction, building, rebuilding, maintenance and repair thereof would be too great or unreasonable and could be materially reduced or lessened by a divergence from the road or route the Commissioner is hereby empowered to divert the course or direction of same and he may diverge from the line or route of same as herein described in such direction or directions as in his discretion may seem best in order to correct said danger or inconvenience or lessen the cost to the Commonwealth.

Section 9. Where a turnpike or tollroad company, or other private corporation, shall own or control the whole or any part of a road or route forming all or any portion of a State highway as hereinbefore described and defined it shall be the duty of the State Highway Commissioner, for and in behalf of the Commonwealth, by an amicable agreement, to purchase said turnpike or tollroad, or such part thereof owned by such company or corporation, and if a fair and reasonable price which shall be approved by the Governor for said road or part thereof cannot be agreed upon it shall then be lawful for the State Highway Commissioner to petition the court of quarter sessions of the county in which the state highway or any part thereof owned or controlled by said turnpike company or other private corporation is located, setting forth that such turnpike or tollroad, or part thereof, is a state highway within the designation and description of this act, and that no agreement as to price or damage can be reached and thereupon said court shall appoint a jury of view, consisting of five reputable citizens of the county in which the road, or part thereof, is located, and said jury shall, after due notice to the company, or corporation, and the State Highway Commissioner, view and condemn said turnpike, tollroad or highway, or part thereof, as a state highway, or part thereof, and shall appraise and report the damages which the owner or owners shall be entitled to receive therefor. Said report shall be presented for confirmation nisi at the term of said court next succeeding said appraisement and view unless by order of said court the same be continued to a later term and if no exceptions are filed thereto, said report shall, at the expiration of thirty days after confirmation nisi, be confirmed absolutely and an appeal therefrom by the Commonwealth, of the company, or corporation, shall lie to the court of common pleas of said county within thirty days after confirmation absolute and upon issue framed by the court of common pleas the damages shall then be ascertained as in similar cases subject to an appeal to the superior or supreme courts as the case may be. Immediately upon agreement reached or upon completion of any court proceedings and acceptance of the appraisement or verdict by the commissioner, the damages so determined or awarded shall be paid by the Commonwealth, together with the expense of the proceedings in condemnation and the said turnpike, tollroad, or part thereof, shall become a state highway, or part thereof, free from tolls. Provided, That if the amount of damages as finally awarded shall be deemed excessive by the State Highway Commissioner, he may refuse to accept the appraisement or verdict and refuse to draw his warrant on the State Treasurer for same and may then omit said turnpike or tollroad, or part thereof, from the aforesaid route of state highway, and all court costs and costs of jury proceedings shall thereupon be paid by the State Highway Department and by necessary divergence therefrom he may select and adopt the next best and most suitable and convenient route or road in order to connect up and complete a continuous state highway and thereafter such diverged route or road shall be taken and remain and be as much a part of the state highways of the Commonwealth as though otherwise particularly described in this act. And Provided Further, That where any existing turnpikes or tollroads, or parts thereof owned by turnpike companies, or private corporations, shall be or form any part of any state highway hereinbefore designated, described or defined, the same are not hereby immediately taken over for improvement or repair but the purchase thereof shall be deferred by the State Highway Commissioner and the same shall remain and be operated and controlled by the owners thereof as heretofore until such time as the work of improvement of all other state highways and parts, or portions, thereof shall have been completed. And Provided Further, If in the judgment of the State Highway Commissioner, local or special conditions of any of said turnpikes or tollroads, or any part, or parts thereof, are such as tend to interfere with, or inconvenience travel thereon, and shall sooner require the purchase, improvement and control thereof by the state then such turnpike or turnpikes, tollroad or tollroads, or part or parts thereof, so affected by such local or special conditions shall be taken over in accordance with the provisions of this act.

Section 10. The State Highway Commissioner is directed to construct or improve, and thereafter to maintain and repair at the sole cost and expense of the Commonwealth, the highways forming the plan or system of the state highways hereinbefore mentioned, and such improvement and maintenance shall be made according to specifications to be prepared by the State Highway Department as regards the character, construction and material to be used and the said work of construction and maintenance of said State highways shall be done under the direction and supervision of the State Highway Commissioner. Provided, however, that where any State highway or part thereof, as herein now described and defined, has been improved by county and township, or borough, or by either, or both, previous to the passage of this act, such highway, by, and with the consent of said county and township, or borough, either or both, as the case may be, shall nevertheless become a State highway the same as though it were improved or constructed under the provisions of this act. Provided Further, That where the supervisors or commissioners of any township, or townships, or the county commissioners of any county or counties, or the councils of any borough or boroughs, either, or both, as the case may be, shall for any valid reason object to the taking over and appropriation of said improved road or roads, or any parts thereof, as a State highway, the said township or county, or borough, or townships, counties or boroughs, as the case may be, shall thereafter maintain, repair and control said improved road or roads, or parts thereof in accordance with the requirements of the State Highway Department.

Section 11. The State Highway Commissioner may at his discretion authorize any borough, or the commissioners of any county or the supervisors or commissioners of any township to repair and maintain any State highway which may lie within the limits of any borough or county or township under the supervision of the State Highway Department and pay to said borough, county or township the cost of said repairs or maintenance.

Section 12. All work of constructing, building or rebuilding of highways, excepting that of repairing and maintenance done under the provisions of this act shall be by contract and shall be according to plans and specifications to be prepared in every case by the State Highway Department and in awarding any contract the work shall be given to the lowest and best bidder with the option on the part of the State Highway Commissioner to reject any or all bids if the prices named for the work of materials to be used are higher than the estimated cost or for any other reason appearing to said commissioner. Every person, firm or corporation, before being awarded any contract for the construction or improvement of any State Highway or of any State-aid highway under the provisions of this act, shall furnish a bond with sufficient surety or sureties acceptable to the State Highway Commissioner in a sum equal to the contract price of the work, conditioned for the faithful and satisfactory completion of the work within the time stated in said contract and that all labor and material-men shall be fully paid and to indemnify and save harmless the State from and damage or expense incurred or caused through the failure of said contractor to complete the work as specified and for any damage growing out of the carelessness or negligence of the said contractor, his servants or employees. Provided, That if in any case in the judgment of the commissioner economy in the first cost to the State and greater efficiency in the work of construction or improvement can be obtained by the work being directly done or carried on by the State Highway Department, no advertisement for bids nor letting of contract for same shall be required.

Section 13. Advertisement for proposals for construction, reconstruction or improvement of all State highways under the provisions of this act shall be made by the State Highway Commissioner at least three weeks before the contract may be awarded by public notice inserted once a week in at least two newspapers of general circulation in the county or counties in which the highway to be improved is located, such advertisements to designate where the plans and specifications may be had and the time and place of the reception of bids and letting of the contract. The State Highway Commissioner may at his discretion insert the same advertisement in other newspapers.

Section 14. Every contract authorized to be made by the State Highway Commissioner under the provisions of this act shall be made in the name of the Commonwealth of Pennsylvania and shall be signed by the State Highway Commissioner and shall be approved as to form and legality by the Attorney General or Deputy Attorney General of the Commonwealth.

Section 15. Before the Commissioners shall undertake the construction, reconstruction or improvement of any state highway on the plan of state highways wherein a change of existing lines and location is necessary and damage is likely to result to abutting property he shall when possible enter into an agreement with the owner or owners of said property as to amount of damage to be paid to the said owner or owners by the State, or in case an agreement satisfactory to the commissioner and said owner or owners cannot be made the commissioner may proceed with the work of construction, reconstruction or improvement and the owner or owners of said property damaged thereby may present their petition to the court of quarter sessions for the appointment of viewers to ascertain and assess such damages. The proceedings upon said petition and by the viewers shall be governed by existing laws relating to the ascertainment and assessment of damages for opening public highways and such damages when ascertained shall be paid by the State Treasurer upon warrant of the State Highway Commissioner.

Section 16. All state highways under the provisions of this act shall be marked with suitable signs having the words "state highway" and year date thereon. and sign and distance boards giving directions to towns or villages shall be erected at cross or intersecting roads, the same to be paid for as part of the cost of the highway. The State Highway Commissioner may also cause trees to be planted and maintained along said highways, the same to be paid for as part of the cost of the road. No street railway shall hereafter be constructed upon any state highway, nor shall any street railway crossing, nor any gas pipe, water pipe, electric conduits, or other piping, be laid upon or in any portion of a state highway except under such conditions, restrictions and regulations as may be prescribed by the State Highway Department. The State Highway Commissioner is empowered to make reasonable rules and regulations governing the use of all state highways and any person violating such rules or regulations, or who shall by the use of rough locks, drag chains, upon wagon wheels or by any other method or device, or in any manner wilfully or maliciously destroy, injure or damage any such highways in this Commonwealth shall be guilty of a misdemeanor and upon arrest and conviction therefor shall pay a fine of not less than ten dollars ($10) nor more than twenty-dollars ($20) for each and every offence, together with the costs of prosecution, which shall be recovered as in similar cases upon complaint of any person before a magistrate or justice of the peace and the fine or fines so recovered shall be paid into the State Treasury.

Section 17. All highways improved and constructed or rebuilt under the provisions of this act shall be Macadam, Telford, or other stone roads, or roads constructed of brick, gravel, cinder, oyster shells, or other good materials, or combination of materials in such manner that the same, of whatever material constructed, will with reasonable repairs thereto at all seasons of the year be firm, smooth and convenient for travel. Provided, That the kind of materials to be used on any particular highway, or part thereof, to be built shall be decided or selected by the State Highway Commissioner before the contract is let. And Provided further, That all state highways shall be constructed and improved to the width of not less than sixteen (16) feet.

Section 18. In addition to his other duties, the State Highway Commissioner shall cause to be made a survey of all the roads in the State and shall cause to be made and kept for the State Highway Department a general highway plan of the State and compile statistics and collect information relative to the mileage, character and condition of the highways in the townships and counties of the State. He shall investigate and determine upon the various methods of road construction best adapted to the various sections of the State and establish standards for the construction and maintenance of highways in various sections, taking into consideration the topography of the country, the natural conditions and the character and availability of road-building material and the ability of the townships and counties to build and maintain roads under the provisions of this act. He may at all reasonable times be consulted by county, city, borough or township officers having authority over highways and bridges and shall, when requested, advise and give information to such officers relative to the construction, repairing, alteration and maintenance of the said highways and bridges. He shall at all times lend his aid in promoting road improvement throughout the State and shall prepare and compile all useful information relative to road building and maintenance, which he shall disseminate by means of printed bulletins issued at such times and in such numbers as he shall deem best.

Section 19. For the purpose of uniform, efficient and economic maintenance and repair of the State highways herein described and defined the said State Highway Commissioner shall appoint and employ all necessary labor or repairmen who shall at all times in the year keep the State highway free from holes, ruts, sticks, loose stones, or other impediments of any kind which tend to interfere with free and easy travel or which if permitted to exist might tend to the deterioration, injury or destruction of the highway.

Section 20. The several counties and townships of the Commonwealth, or any of them, either jointly as county and township, or severally expressing a desire to the State Highway Department in manner hereinafter required for State-aid shall from and after the passage of this act be entitled to receive the aid and co-operation of the State in the improvement and subsequent maintenance of any road or highway in any county or township of the Commonwealth not herein defined as a State highway when complying with the provisions of this act governing same. The State when granting the aid and co-operation desired shall not in any case pay more than fifty (50) per centum of the cost of any road improvement nor more than fifty (50) per centum of the maintenance thereafter and the remaining fifty (50) per centum of the cost and expense of improvement shall be paid, to wit, twenty-five (25) per centum by the county and twenty-five (25) per centum by the township when the application for said aid is joint by county and township and thereafter the township shall pay fifty (50) per centum of the entire cost of maintenance. Provided, That counties or townships may agree between themselves to contribute their joint proportion of the fifty (50) per centum of the total expense of any improvement herein required to be borne by them in different proportions from that herein specified. Where any township or county road or highway is desired to be improved by a county or township without the joint action or co-operation of the other, then said county or township, as the case may be, shall pay the entire fifty (50) per centum of the cost of the road improvement and fifty (50) per centum of the cost of maintenance thereafter. Provided, That any township desiring the aid and co-operation of the State in the permanent improvement of any of its roads shall levy a cash road tax to meet the cost of such permanent improvement and shall levy annually thereafter such further road taxes in cash as are sufficient to pay the township's share of the annual maintenance of such highway. And Provided Further, It shall be lawful for any township or county of the Commonwealth to incur indebtedness or to issue bonds in the manner authorized by law for the payment of said township's or county's share of the cost of any permanent road improvement or maintenance undertaken under the provisions of this act.

Section 21. The State shall not furnish any aid or co-operation in the permanent improvement or maintenance of any county or township road or highway to be improved as a State-aid highway until and unless the supervisors or commissioners of the township in which the road desired to be improved lies where the improvement is intended to be made jointly by township and county shall first petition the county commissioners of the county, representing that any principal highway or section thereof lying within said township is in need of reconstruction and setting forth that said township desires to take advantage of the provisions of this act to improve said highway, it shall then be the duty of said county commissioners to adopt a resolution authorizing the assumption by the county of its share of said improvement and the said county commissioners shall then promptly petition the State Highway Department for the aid and co-operation of the State as desired for the particular road to be improved. Said petition of the county commissioners shall be accompanied by the said township petition and it shall state the desire of both township and county that said road or highway shall be improved and maintained as a State-aid highway according to such plans and specifications as shall be prepared by the State Highway Department that the county and township or townships agree to pay fifty (50) per centum of the cost and expense of such improvement and the township or townships will thereafter, in consideration of the aid and co-operation of the State so granted, pay fifty (50) per centum of the cost of repair and maintenance thereof. Such roads to be at all times under the authority and supervision of the State Highway Department. Said petition shall further state that petitioners upon approval thereof by the State Highway Department, will enter into an agreement with the Commonwealth, to be approved by the Attorney General, which shall embody and contain all matters of detail concerning the improvement, maintenance and repair of the highway to be improved. Provided, When the aid and co-operation of the State in the improvement of any highway is desired by any county or township without the intervention of the other, said county or township, if it shall agree to pay one-half of the cost of the improvement and maintenance thereof, shall be entitled to receive the aid and co-operation of the State in like manner as in cases of joint applications by county and township. And provided further, That no State-aid shall be paid or given, nor shall any work be commenced in the improvement of any road or highway in any township or county of this Commonwealth until said agreement shall have been duly executed by the respective parties pursuant to due and legal municipal and corporate action of both township and county and the State Highway Commissioner shall then advertise for bids and let contract or contracts for the improvement of the road desired to be improved in the manner herein provided in the case of improvement of State highways. And provided further, That the State Highway Commissioner may enter into contracts at any time in amounts equal to the State appropriation then available plus the respective shares of the counties, townships and boroughs.

Section 22. In any township of the Commonwealth wherein the owners of the majority of the assessed valuation of real estate therein shall desire any principal road or highway, being and lying in their said township, to be improved and maintained as a State-aid highway they may petition the supervisors or commissioners of their said township for said improvement to be made and require them to petition the county commissioners of the county to make application to the State Highway Department for the aid and co-operation of the State in the improvement and maintenance of said highway, whereupon the duty of the county commissioners in the premises shall be the same in form and procedure as in other cases hereinbefore provided.

Section 23. In all cases where the township supervisors or commissioners, or county commissioners, refuse to act upon or unduly delay action on any petition for the improvement and maintenance of any road or highway as a State-aid highway any citizen taxpayer of the township or county may, by petition, present the facts of the matter to the court of quarter sessions requesting the court to order such action thereon as the case may require and if after due hearing had before said court it shall appear that the truth of the matters alleged in the petition are sustained the court shall make an order directing the township supervisors or commissioners, or county commissioners, as the case may be, to forthwith act upon said application or applications for State-aid and that said application or petition for the improvement be forthwith forwarded to the State Highway Department.

Section 24. If within thirty days after the receipt of any petition for highway improvement in any township under the provisions of this act a petition signed by the owners of a majority of the assessed valuation of real estate in said township is received by the county commissioners of the county in which said township is located protesting against said proposed expenditure upon the part of the township then the county commissioners shall take no action on said petition for improvement but shall return the same to the township supervisors or commissioners from whom it was received.

Section 25. Whenever the county commissioners of any county shall represent by petition to the State Highway Commissioner that any principal highway in said county, outside the corporate limits of any city, is not in a satisfactory condition for comfortable and easy travel at all seasons of the year and ought to be reconstructed as a State-aid highway it shall be the duty of the State Highway Commissioner, or any assistant directed so to do, to examine such highway and if in the judgment of the State Highway Commissioner said representation is well founded he shall determine what changes should be made in said existing highway, what portion of it should be improved and in what manner, and shall make the necessary survey, prepare accurate plans and make detailed estimate of the expense of the work which in his opinion should be done and report the same to the county commissioners of the county and the supervisors or commissioners of the township or townships in which said highway may lie. If the said county commissioners and township supervisors or commissioners then decide that it is advisable to go on with the work they, the said county commissioners and township supervisors or commissioners, shall enter into the agreement with the State Highway Department hereinbefore specified. Provided, however, said improvement shall not be commenced until the funds at the disposal of the State Highway Department for such purpose shall be sufficient to meet the cost and expense of the improvement desired.

Section 26. The State-aid authorized by the provisions of this act in the construction of State-aid highways shall be ratably apportioned among the several counties of the Commonwealth by the State Highway Commissioner according to the mileage of township and county roads in the respective counties and the said amounts or apportionments shall remain in the State Treasury until applied for in accordance with the provisions of this act. Provided, however, That if in any case the amounts or apportionments so apportioned shall not be applied for before the first day of May in each year, the same shall thereupon be ratably allotted to such county or counties as have during that year applications requiring the expenditure of sums in the improvement of State-aid highways greater than the amount of their apportionment.

Section 27. All highways improved as State-aid highways shall conform to the provisions of this act and the rules and regulations of the State Highway Department as provided in case of State highways. Provided, That no section of State-aid highways improved under this act shall be less than one-half mile in length, nor shall the improved portion thereof be less than twelve feet in width.

Section 28. The work of maintaining and repairing all State-aid highways improved under the provisions of this act shall be done by the State Highway Department and fifty (50) per centum of the cost thereof shall be paid by the several townships or boroughs wherein such roads may lie, or by the county when such roads have been improved upon the petition of such county without the co-operation of the township.

Section 29. Where a portion of a highway traversing one or more townships and for the improvement and maintenance of which as a State-aid highway according to the provisions of this act, application has been made by said township or townships shall lie within the limits of or traverse any borough or boroughs or any incorporated town or towns, and where the failure of said borough or boroughs, or incorporated town or towns to improve the said highway would leave a break or unimproved section in a continuous improved highway it shall be lawful for the county commissioners of the county in which said highway is located to enter into an agreement with said borough or boroughs, or incorporated town or towns, to bear a portion of the expense of said improvement of the highway within the limits of the said borough or town in the same manner as herein provided for the cooperation between the counties and townships. Provided, That an improved road shall have been previously constructed in an adjoining township or borough to the lines of the borough or town making application or petition for such improvement, the State Highway Commissioner is authorized to bear a portion of the expense of said improvement of said highway within said borough or town limits, but in no case shall the portion of said expense to be borne by the State exceed fifty (50) per centum of the total expense of said improvement, boroughs shall only receive aid from the State as aforesaid in cases where failure to receive such aid would prevent a continuous improvement of an important State-aid highway. Provided, That any borough or incorporated town which is willing to pay one-half the cost of constructing any such road as hereinbefore mentioned may make application direct to the State Highway Department. All improvements made in borough or town highways as herein provided shall be of a character similar to that specified for the township or townships through which the highway to be improved passes in reaching said borough or town. Provided, however, That the council of any borough or boroughs or incorporated town or towns through which such highway passes shall before its construction, by proper ordinance. enter into an agreement with the State Highway Commissioner for the payment of said borough's or town's share of the cost of construction and of the subsequent maintenance of such portion of said State-aid highway as lies within the limits of said borough or town similar to that required elsewhere in this act of the commissioners or supervisors of townships.

Section 30. Any county, township or borough may, through its commissioners, or supervisors, or councils, bid for the construction or improvement of such portion of any State-aid highway undertaken under the provisions of this act as may lie within its limits and any county, township or borough submitting such bid shall have the same consideration and shall be governed by the same rules and regulations of the department as in the case of other bidders and if awarded the contract shall fulfill the same and be subject to the same conditions and regulations as herein provided for other contractors.

Section 31. Where any person or corporations shall sustain damage by the taking of land to alter the location of any State-aid highway which may be improved under this act, and the county commissioners and township supervisors or commissioners and parties so injured cannot agree on the amount of damage sustained, such persons or corporations may present their petition to the court of quarter sessions for the appointment of viewers to ascertain and assess such damages and the form and procedure therein shall be governed by existing laws relating to the assessment of damages in opening public highways and such damages when ascertained shall be paid fifty per centum (50) by the State and twenty-five per centum (25) by the county and twenty-five per centum (25) by the township. Provided, Where the land so taken is in connection with the improvement of State-aid highway which is being done upon the petition of township or county alone and not jointly by the township and county then fifty per centum (50) of the damages sustained shall be paid by the county or township.

Section 32. The total cost of the improvement and maintenance of the State-aid highways constructed under the provisions of this act shall be paid by the State Treasurer as provided by the terms of the contract or otherwise as herein provided upon the warrant of the State Highway Commissioner, attested by the chief clerk of the State Highway Department, out of any appropriation or appropriations made by the Legislature to carry out the provisions of this act. The share of the county shall be paid as provided by its contract and otherwise by the provisions of this act to the State Treasurer by the county treasurer upon the warrant of the county commissioners in such sum or sums as shall be certified by the State Highway Commissioner from time to time during the performance of the work or contract or as provided by the contract, and otherwise, by the provisions hereof, after the same shall be completed. The share of the township or townships, or of any borough or boroughs, shall be paid to the State Treasurer by the township supervisors or commissioners, or by the borough treasurer, as the case may be, in the manner and form as in the case of counties and as other debts of said townships or boroughs are paid when and as demanded by certificate of the State Highway Commissioner during the performance of the work or contract, or in like manner after the same shall be completed. Upon the completion of any State-aid highway improvement, or upon the ascertainment of any additional improvement, cost or of any maintenance expense incurred thereon thereafter by the State Highway Department, the State Highway Commissioner shall certify the same to the State Treasurer and to the county commissioners and township supervisors or borough authorities, as the case may be, the respective shares of said cost or expense for which the county, township or borough is liable. If the said shares or amounts so certified by the State Highway Commissioner of the cost and expense of the improvement, or of the subsequent maintenance thereof as provided by contract and the provisions of this act of the county, township or borough, or all or either of them, shall not be paid to the State Treasurer within thirty days after being so certified, then the said shares of the county, township or borough, either, or all of them, remaining unpaid shall be charged by the State Treasurer against any funds of said county, township or borough which may be in the hands of the State Treasurer, or which may thereafter come into his hands, excepting school funds, and may also be recovered by action at law or equity as any other debts of such counties, townships or boroughs are by law recoverable. The amounts paid under this act to the State Treasurer by the counties, townships and boroughs shall be placed by him to the credit of the proper fund for highway construction or maintenance and shall immediately be available for the use of the State Highway Department for construction or maintenance, as the case may be. The State Highway Commissioner may make partial payments to any contractor performing any highway improvement under this act as the same progresses upon estimate made by the State Highway Department, but not more than ninety per centum (90 per centum) of the estimate of work done, or of the contract price shall be paid in advance of the full and satisfactory completion of said improvement and acceptance of same by the State Highway Commissioner.

Section 33. The word highway as used in this act shall be construed to include any existing causeway or bridge, or any new causeway or bridge, or any drain, or water course, which may form part of a road and which might properly be built according to any existing laws by the townships of the Commonwealth. A state-aid highway, as the term is used in this act, shall be construed to mean only such highway as is improved with the aid and co-operation of the State with county and township, or with county, or township, or borough, either, or both, as the case may be, according to the terms and provisions hereof, but shall not include any causeway or bridge which should properly be built by the county, or by the State under existing laws.

Section 34. All State-aid highways under the provisions of this act shall be marked and suitable sign boards erected and maintained at cross roads as provided in the case of State highways, and the same shall be paid for as part of the cost and maintenance of the highway.

Section 35. The State Highway Commissioner shall compile and prepare a plan or plans of all State-aid highways in the Commonwealth, which shall show and contain all the information required to be shown and contained upon the maps or plans of State highways so that the Department shall at all times have a complete record of the same. In order that the said plan or plans of State-aid highways may be authentic and complete in all respects the county commissioners or county engineers of the several counties of this State and officials of all cities, boroughs and townships in the State which now have, or may hereafter have by law, authority over the public highways and bridges, shall, upon written request of the State Highway Department, furnish said Department with any information relating to the mileage, cost of building and maintenance, condition and character of the highways under their jurisdiction and with any other needful information relating to said highways.

Section 36. The sum of .... dollars, or as much thereof as may be necessary in establishing and carrying on the work of the Department, is hereby appropriated for the two years beginning June first, nineteen hundred and eleven, and May thirty-first, nineteen hundred and thirteen, for the purpose of maintenance, repair and construction of the State highways herein described and for the payment of the State's share of the maintenance and repair of State-aid highways constructed or improved under the provisions of this act.

Section 37. The sum of .... dollars, or as much thereof as may be necessary in carrying on the work of the Department, is hereby appropriated for the two years beginning June first, one thousand nine hundred and eleven, and ending May thirty-first, one thousand nine hundred and thirteen, for the purpose of State-aid in the permanent improvement of the highways herein described as State-aid highways.

Section 38. All money at any time appropriated for the use of the State Highway Department for the improvement and maintenance of State-aid or State highways shall always remain for the use of the department until the same is entirely used and applied to the purpose or purposes for which it was appropriated.

Section 39. The act approved the fifteenth day of April, Anno Domini one thousand nine hundred and three, entitled "An act providing for the establishment of a State Highway Department by the appointment of a State Highway Commissioner and staff of assistants, and defining the powers and duties thereof, authorizing the State Highway Department to co-operate with the several counties and townships and with boroughs in certain instances in the improvement of the public highways and the maintenance of improved highways, providing for the application of counties and townships for State-aid in highway improvement and maintenance, providing for the payment of the cost of highway improvements made under the provisions of this act by the State, the counties, and the townships, and making an appropriation for this purpose," and the act approved May first, one thousand nine hundred and five, entitled "An act providing for the establishment of a State Highway Department by the appointment of a State Highway Commissioner and staff of assistants, and defining the powers and duties thereof authorizing the State Highway Department to co-operate with the several counties and townships and with boroughs in certain instances in the improvement of the public highways and the maintenance of improved highways, providing for the application of counties and townships for State-aid in highway improvement and maintenance, providing for the payment of the cost of highway improvements made under the provisions of this act by the State, the counties and the townships, and making an appropriation for this purpose, and providing a penalty for maliciously destroying improved roads," and amendment thereto approved June eighth, one thousand nine hundred and seven, entitled "An act to amend an act entitled 'An act providing for the establishment of a State Highway Department by the appointment of a State Highway Commissioner and staff of assistants, and defining the powers and duties thereof, authorizing the State Highway Department to co-operate with the several counties and townships and with boroughs in certain instances in the improvement of the public highways and the maintenance of improved highways, providing for the application of counties and townships for State-aid in highway improvement and maintenance, providing for the payment of the cost of highway improvements made under the provisions of this act by the State, the counties and the townships, and making an appropriation for this purpose and providing a penalty for maliciously destroying improved roads,' approved the first day of May, Anno Domini one thousand nine hundred and five, increasing the number of employes of the State Highway Department and fixing the amounts of their salaries, eliminating from the items included in the expense of construction and from those covered by damages the cost of changes of grade, extending the provisions of the act to incorporated towns, increasing the percentage which may be paid to contractors in advance of the final completion of the work, authorizing the setting of monuments and planting of trees along State highways, prohibiting the construction of gas or water lines along State highways except under certain conditions, and providing that the kind of roads to be built shall be decided by the State Highway Commissioner," and all other acts or parts of acts inconsistent herewith are hereby repealed. Provided, That the provisions of this act shall not be construed to repeal any of the provisions of the road acts approved June twenty-sixth, one thousand eight hundred and ninety-five (Pamphlet Laws, three hundred and thirty-six) and June twenty-three, one thousand eight hundred and ninety-seven (Pamphlet Laws, one hundred and ninety-four), and July ten, one thousand nine hundred and one (Pamphlet Laws, six hundred and thirty-six), nor the provisions of an act approved June seventh, one thousand nine hundred and one, entitled "An act relating to railroad crossing of highways and for the regulation, alteration and abolition of grade crossings, except in cities of the first and second class," nor the provisions of an act approved April tenth, Anno Domini one thousand nine hundred and five (Pamphlet Laws, one hundred and twenty-nine), entitled "An act relating to the management, care and maintenance of the National or Cumberland road, and freeing the same from tolls, and making an appropriation therefor," nor the provisions of an act approved the thirteenth day of June, Anno Domini one thousand nine hundred and seven (Pamphlet Laws, seven hundred and thirty-nine), entitled "An act extending the provisions of an act approved the tenth day of April, Anno Domini one thousand nine hundred and five, entitled 'An act relating to the management, care and maintenance of the National or Cumberland road, and freeing the same from tolls and making an appropriation therefor,' to the portion of said road lying within Somerset county, directing the State Highway Commissioner to divide the said road into four divisions, and to employ a superintendent for each division, fixing the salaries thereof, making an appropriation for the purpose of this act and repealing all acts or parts of acts inconsistent herewith or supplied hereby." Nor the provisions of an act approved April twenty-seventh, Anno Domini one thousand nine hundred and nine (Pamphlet Laws, two hundred and sixty-five), entitled "An act relating to motor vehicles, regulating their speed upon the public streets and highways of the Commonwealth of Pennsylvania, providing for their registration and the licensing of operators by the State Highway Department, establishing the rights of motor-vehicles upon the public highways with relation to other vehicles, regulating the service of process and of proceedings in actions for damages arising therefrom, prescribing the penalties for violations of the provisions of this act, and providing for the disposition of fines imposed thereunder." And Provided Further, That any State-aid highway improvement under contract or in process of completion at the date of the adoption of this act shall not be affected by the provisions thereof, but the same shall be completed, finally settled, paid for and accepted by the Department in accordance with the terms and provisions of said acts and supplements and amendments thereto.

Section 40. All duties, responsibilities, powers or jurisdiction conferred upon the State Highway Commissioner and upon the State Highway Department as previously created by acts of Assembly now in force and which do not conflict with the provisions of this act are therefor not repealed by this act, and shall be assumed by and are hereby conferred upon the State Highway Department and the State Highway Commissioner created under this act.

....
President pro tempore of the Senate.

....
Speaker of the House of Representatives.

Approved—The .... day of ...., A. D. 1911.

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It is proposed to amend the Constitution of Pennsylvania to permit of a bond issue of $50,000,000 to defray the cost of a comprehensive system of State highways, and it is reported that some such measure will be considered by the present Legislature.

THE ROAD SITUATION IN PENNSYLVANIA

By Logan Waller Page.*

Considering its wealth and population, Pennsylvania has the poorest roads of any state in the Union. The total assessed valuation of property in this State and the total expenditure for public roads exceeds that of any other state except New York, but there are 32 states in the Union which have a larger percentage of improved roads. According to a road census taken by the Office of Public Roads in 1904, Pennsylvania had 2 1-10 per cent. of its roads improved, but New York had 7 9-10 per cent. improved—and according to recent information from that State, New York now has over 16 per cent. of its roads improved. Ohio stands next to Pennsylvania in expenditure for public roads, but in 1904, Ohio had 33 7-10 per cent. of its roads improved. Our 1904 census showed the total road mileage of the State of Pennsylvania to be 99,770, of which only 2,161 miles were reported as having been surfaced with broken stone.

That Pennsylvania needs better roads, there can be no question. The benefits that flow from improved roads are so varied and of such vast importance, that the work of highway improvement becomes almost imperative. These benefits come in the nature of increased land values, better facilities for transportation of farm and other products, increased population, improved schools, and better social conditions throughout the rural communities.

It has been variously estimated that the average increase in land values resulting from improved highways ranges from $2 to $9 per acre. There are in the State of Pennsylvania about 20,000,000 acres of farm land. The increase in the value of this land resulting from road improvement would more than pay for the improvement of the main highways. Assuming one mile of improved road is built to each square mile of farming land, and that the increased value would be only $5 per acre, the total increase from this source alone would amount to about $100,000,000. According to the report of the Secretary of Internal Affairs of Pennsylvania for 1908, only 65% of the farms of Pennsylvania are improved, but with a system of improved roads practically all of the available farm lands in the State would be cultivated.

Professor Latta of Purdue University, Lafayette, Indiana, a few years ago collected data from farmers throughout that State, which showed that the average annual loss resulting from poor roads in Indiana was about 76 cents per acre. If this is also true of Pennsylvania, then the loss due to bad roads in this state on farm land alone, amounts to something like $15,000,000 annually.

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At the present time there are in the Keystone State about 2 2-10 miles of public road to every square mile in area, which greatly exceeds the mileage that it would be necessary to improve in order to provide a proper system of transportation. One mile of improved road to every square mile in area would be ample for the most densely populated farming districts. By a careful traffic census it will probably be found that not over 15 or 20 per cent. of the roads carry from 80 to 90 per cent. of the traffic, so that it will probably be unnecessary to improve more than 15 to 20 per cent. of the roads of the State in order to meet the present needs of the great majority of your people.

The principal advantage to be gained from highway improvement is through its relationship to agriculture. The ease and facility with which the products of the farm can be placed on the market depends upon the condition of the roads. Although Pennsylvania is looked upon as a manufacturing and mining state, it will be found by examining the reports of the U. S. Department of Agriculture that it is also a great agricultural state. Many of the staple products of the country are raised here in large quantities and those products over and above what are required for home consumption, must be placed on the markets and sold for cash before the farmer can realize the reward of his labors.

It has been found by various investigators working along different lines that the cost of hauling in this country amounts to from 23 to 25 cents per ton per mile. In France, England, Germany and Switzerland, where practically all of the roads have been improved, the cost of hauling amounts to only about 10 cents per ton per mile, or less than one half of what it costs on the average road in this country. If the roads in this country were improved equal to those of the European countries mentioned, and the cost of hauling reduced to the same basis that it is in those countries, the annual saving in this State alone would run well into the millions.

Your corn crop in 1910 amounted to 65,026,000 bushels valued at $38,000,000. The average cost of hauling corn in Pennsylvania, according to Bulletin 49, Bureau of Statistics, U. S. Department of Agriculture, is 7 cents per hundred pounds, or .0392 cent per bushel. On this basis the total cost of hauling the 1910 corn crop was $2,549,019.20. If the roads of the State were improved so that the load could be doubled or the time shortened, and the cost of hauling reduced to about half, an annual saving of $1,274,509.60 could be effected on the corn crop.

Your 1910 wheat crop amounted to 27,697,000 bushels valued at $25,000,000. The average cost of hauling wheat in Pennsylvania, according to the same authority above, was 7 cents per hundred pounds, or .042 cent per bushel. On this basis the cost of marketing the 1910 wheat crop amounted to $1,163,274. If half of this cost could have been saved, it would result in a saving of $581,637.

Your 1910 oat crop was 35,130,000 bushels valued at $14,000,-

000,000. According to the same authority, the cost of hauling oats in Pennsylvania was 12 cents per hundred pounds, or .0384 cents per bushel. On this basis, it cost $1,348,992 to put the oat crop on the market, and if this cost could have been reduced to half, a saving of $674,496 would have been effected.

In 1910 there were 4,433,000 tons of hay produced in Pennsylvania valued at $66,000,000. The average cost of hauling hay in Pennsylvania is 12 cents per hundred pounds, or $2.40 per ton. On this basis, it cost $10,639,200 to haul the hay crop to market, and if half of this cost could have been saved, the enormous sum of $5,319,600 could have been saved on the 1910 hay crop.

In 1910, 28,160,000 bushels of potatoes valued at $14,000,000 were produced. The average cost of hauling potatoes to market in Pennsylvania is 9 cents per hundred pounds, or .054 cent per bushel. On this basis, the cost to place the 1910 potato crop on the market was $1,520,640. If half of this could be saved it would amount to $760,320. This makes a grand total of $8,610,562 that could be saved on these five staple products of the 1910 crop which is more than the total annual outlay for the construction and maintenance of all your State, county and township roads. A large quantity of the products here mentioned were consumed on the farms, but to offset this, other miscellaneous crops, merchandise, fruits, vegetables, and the products of mines and forests would probably aggregate equally as much or more.

The loss in dollars and cents is by no means the only loss to the people of the State on account of bad roads. The rapid trend of population from country to city has been frequently commented upon as a cause for grave concern. In 1790, only 3 4-10 per cent. of our population dwelt in cities; but to-day about 45 to 47 per cent. of our people live in cities of 2,500 population and over. If this increase in city population continues, we will hear more in the future about the "high cost of living" than we have in the past. Thousands of acres of farm lands are now lying idle and unproductive, which, with a system of good roads, would be tilled and made to produce the crops of which they are capable.

An examination of the statistics of population in counties possessing first-class roads will reveal the fact that in almost every case the population has increased, while the sections of the country which have lost in population are conspicuous for bad roads.

In 25 counties selected at random and located in various states, an actual decrease in population amounting to 77,800 was shown for the ten-year period 1890-1900. These same counties showed an average of only 1½ per cent. of roads improved. Twenty-five other counties located in the same states showed an increase in population for the same period of 778,000, but in these counties 40 per cent. of the roads were improved.

A few years ago an effort was made in Smith County, Missouri, to issue bonds for road purposes, but the people were told that the $100,000 bond issue of the neighboring county of Putnam was a great burden to the people. Smith County allowed itself to be dissuaded from issuing the bonds. The work continued in Putnam County, however, and $150,000 additional was issued. The census of 1900 showed a loss in population of 450 in Smith County and a gain of 2,000 in Putnam County.

In 1892 the assessed valuation of the property in Abbington Township, Montgomery County, Pennsylvania, was $3,900,000 and the road tax for that year was $15,000. The expenditure of that amount produced no permanent results. A road association was organized about that time and urged that bonds be issued for macadamizing the roads. Eighty thousand dollars was raised in this way in 1893, and $50,000 in 1894, and many of the roads were improved. In 1910, the assessed valuation of Abbington Township was $7,695,785, and it is said that the population of the township has practically doubled.

The efficiency of rural schools, church attendance, and social conditions in rural communities are dependent upon the highways. In five states which rank foremost in mileage of improved roads, the average school attendance in 1904 was 78 out of every 100 pupils enrolled; while in five states with roads conspicuously bad, the average was 59 out of every 100 pupils enrolled. If the road conditions are such that the pupils cannot reach school regularly so as to get the full benefit of each school day, the maximum efficiency of school cannot be obtained.

In the early history of our country the movement for improved roads took the form of the construction of toll roads by private corporations and the building of great highways by the National Government. Both of these methods were abandoned about the time that the first railroads were built, and the whole responsibility for building and maintaining the highways was turned over to the local authorities of the counties or townships throughout the various states. The systems under which these local authorities maintained the highways was that of extreme localization, borrowed from England when the colonists first came to America. Under this system, the state contributed nothing to the cause in the way of money, aid or supervision, and the county or township relied on local revenues, consisting mainly of statute labor, for prosecuting the work. For a long time this system seemed to be adequate to the needs of existing conditions, but it has long since become obsolete, and should be abandoned in every state, for the reason that it fails to secure skilled supervision, provides inadequate revenue, depends upon a purely unskilled and unreliable class of labor, and practically precludes any construction of a permanent character. It is a significant fact that no state or community has ever built or maintained a system of first-class roads where the taxes have been worked out, or where the statute labor system is in full force. The policy of having all road taxes paid in labor has been found to be one of the greatest detriment possible to road building. I am glad to note, however, that it is now being abolished in many sections of the country.

John L. McAdam, in writing on this subject in 1824, said: "Statute labor was declared by Parliament at a time when no better means could be devised: when a circulating medium was deficient, and when a fair quantum of labor could not, in many parts of the country, be obtained for money. Personal labor for public service can never be made profitable or fairly productive. Skill and executive labor must be adequately paid for." The system which McAdam condemned 85 years ago is essentially the same as that which is in use in Pennsylvania to-day on at least 75 per cent. of the highways. Under this system a great host of petty road officials are employed, each of whom undertakes the improvement of the roads according to his own ideas and without any central or competent authority to direct his labors. In Pennsylvania there are nearly 5,000 township supervisors, who are authorized to divide their townships into districts containing not less than five miles of road, and to appoint a road master for each district. If this law were carried literally into effect, you would have, in addition to your 5,000 township supervisors, about 20,000 road masters in the state. As a matter of fact, I do not suppose the number of road masters exceeds 10,000 or 12,000. These road masters are authorized by law to work the roads and to superintend the work.

I do not doubt for an instant that you may have many skilled road builders in Pennsylvania. Many of your local supervisors and road masters are industrious, hard-working and well-meaning men, but the great majority of them know very little about road building and some of them are unable to solve the most simple road problems. It is apparent, therefore, that your present system of road administration, so far as the great bulk of highways in the State is concerned, is heavily encumbered with officials, none of whom have complete authority to formulate or direct a definite road policy, and each receiving such a small salary that he cannot afford to devote his entire time and attention to the work.

It is my opinion that you would obtain better results if you would place the administration of road affairs of each county in the hands of one competent man having full authority to formulate plans and prosecute the work of improving and maintaining the highways throughout the county. This system is now in operation in Allegheny County of this State, for all county roads, and might well be applied to township as well as county roads throughout the State. It is very similar to the French patrol system and it is well known that on account of the superb system of maintenance which has been practiced since it was adopted by Napoleon, that the condition of roads in that country is second to none in the civilized world.

It appears from your statutes that the various townships are authorized by law to adopt what is known as the money system, and that for the townships adopting this system the state will give a bonus of 15 per cent. of the cash road taxes so collected. I have no knowledge that this provision of law has even been carried out but it is certainly worthy of trial. The various townships and counties of Pennsylvania spent on local roads in 1904 about $5,000,000, and we have every reason to believe that the expenditure at the present time for this purpose amounts to six or seven million. It is apparent to all those who have studied this subject, that at least one-half of this vast sum is absolutely wasted each year. Many of those who discharge their taxes in labor have no further interest in the work than to meet their tax obligations, and in many instances the roads would be better if they were not touched. Skill and experience should be considered essential qualifications for those who are to construct and maintain the public roads, but I see nothing in your statutes to indicate that supervisors or road masters must be so qualified before they can assume the responsibility of spending the people's millions.

My advice to you, therefore, is to pass a law requiring all road taxes to be paid in cash, and providing that the present township system of working the roads be abolished. Objections may be urged to the passage of a compulsory cash tax law on the ground that the supervisors would oppose it, but let me call your attention to the fact that in 1900, 1,338 supervisors expressed themselves in writing to the effect that they were in favor of a cash tax system, while only 519 supervisors expressed themselves as being opposed to it. For the present township system, I would recommend a county system which would provide for the appointment by the Commissioners of each county of a competent and skilful highway engineer or superintendent, who should have charge of all local roads and should have authority, under the direction of the county commissioners, to employ construction gangs and caretakers, and to purchase material, machinery, tools, and equipment. He should have sufficient compensation to justify him in devoting his entire time and attention to the work and the same should be true of all his subordinates. Under such a system properly administered you would be apt to secure a dollar's worth of work for each dollar expended which is certainly not the case at the present time. This system has been recently adopted in the States of West Virginia, Missouri and Kansas and there are several other states in which all local roads are built and maintained under the direction of county officials.

It is the general impression, I believe, that road materials are scarce in Pennsylvania but the report of the State Agricultural Department for 1900 shows that stone suitable for road building is available in 1,224 townships and that there are only 174 townships in the State in which road materials are scarce. It is true, however, that the road materials of the State are, as a general rule, poor, and that there are only a few counties in which first class road material is found in large quantities.

In order to supply material to the counties where suitable rock is not available, I would recommend a plan which has proven very successful in Illinois, California and Washington, and that is of establishing quarry camps in different parts of the State where suitable rock is available and have the rock blasted, crushed and loaded on cars by the use of prison labor. From the annual report of the U. S. Department of Commerce and Labor for 1905, I find that you have about 2,000 idle prisoners in this State. By the use of proper machinery this vast army of prisoners would be able to turn out thousands of tons of road material annually. In California the output averages one and one-half tons per convict per day. On this basis, your 2,000 prisoners would produce about a million five hundred thousand tons of material annually which would be enough to construct 650 miles of road 14 feet wide and 6 inches deep. In the western part of the State the prisoners might be employed in making paving brick from the shale for use on heavy traffic country roads. The railroads would be greatly benefited by improved roads and could well afford to haul the material at a minimum cost and to take their pay for hauling it in ballast as is done in the State of Illinois.

I understand that the prisoners in your State are now idle on account of the objections raised by manufacturers and labor unions to the fact that prison-made goods were sold in competition with similar goods produced by free labor. If the prisoners were used in preparing road material, free labor, instead of being discriminated against would be directly aided by receiving employment in building roads which might not otherwise be built. It has been found that this work is conducive to the health and discipline of the prisoners wherever it has been tried. I notice that your State Highway bill, now pending, provides for prison labor in road work, but I think that the bill should be so amended as to provide that the prisoners should be used in preparing material rather than in constructing roads. The adoption of this plan would greatly reduce the cost of permanent roads and would enable many counties, townships and boroughs to build stone roads which cannot afford, or think they cannot afford, to do so at the present time.

On account of soil, climatic, topographic, traffic conditions and of the cost of labor and materials, road building in Pennsylvania is probably more expensive than in any other state in the Union. I understand that the average cost of stone roads in this State is about $10,000 per mile. It seems to me that one of the first duties of your new State Highway Department should be to make a thorough study of the situation in your state and other states and to devise if possible some cheaper forms of construction which would be better adapted to your local needs than the methods now employed. Heretofore I understand that the Telford macadam method has been used almost exclusively throughout the State. I think it is a great mistake to use Telford foundations except where the conditions absolutely require it. The "V" shaped type of foundation adopted by the Massachusetts Highway Commission is cheaper because it can be built without the use of hand labor. The Office of Public Roads has been directing the building of object lesson and experimental roads in various parts of the United States since 1895 and up to the present time it has not been found necessary in any case to resort to the Telford foundation. We have found that plain water bond macadam built of trap rock or some other hard tough stone with a good cementing value has served the purpose for the average country road, but where automobile traffic exceeds that of horse drawn traffic we have found that even the best macadam roads must be surfaced with some bituminius binder such as liquid asphalt or tar. The shearing action of the wheels on the surface of the road, combined with the grinding and pounding action of the wagon wheels and horses' hoofs tend to pulverize and loosen the surface. The high speed automobiles lift this material into the air and the wind and rain carry it away leaving the surface rock exposed. This condition is being effectually overcome, however, by adopting the bituminous form of construction and at the same time greatly reducing the cost of maintenance.

I have read over your Senate Bills Nos. 103 and 104 which provides for the establishment of a State Highway Department and for the building of a trunk line system of roads by the State and for co-operation in the construction and maintenance of certain county and township roads. On the whole I think these are excellent measures, especially the plan of having the State take over and build a great system of trunk line roads. This is a very essential provision because road improvement should be carried forward with the ultimate idea of developing a continuous system of trunk line roads.

Another excellent feature of your proposed bill is that which provides for the payment by the State of one-half the cost of building important county and township roads. Your bills also provide that the whole cost of maintenance of trunk line roads and one-half the cost of maintaining state aid roads shall be paid by the State and that the work be carried on under the direction of your Highway Department. These are excellent features. Road maintenance is of as great or even greater importance than road construction for the reason that the best roads if neglected soon go to ruin. It has been found, as a general rule, that county or township authorities cannot be depended upon to maintain state aid roads if left to their own methods or discretion.

The section of Bill No. 103 which provides for the establishment of the State Highway Department does not appear to improve your present State law except that the personnel of the Highway Department is enlarged and its duties and responsibilities increased. We have prepared in the Office of Public Roads quite a number of model bills, some of which have been adopted while others are still being considered by the various legislatures.

In all of these measures we recommend that a state highway law should be so framed as to remove its adminstration as far as possible from political influences. We therefore provide in these bills that a non-paid highway commission shall be appointed to consist of a dean or professor of civil engineering from each of the two leading universities or colleges of the State and one member to be appointed by the Governor. A commission thus constituted would have a majority of its members selected because of their training and engineering ability and without reference to their political affiliations which would result in a non-partisan and technically competent commission; while the civilian member to be appointed by the Governor should bring to the commission the business ability and experience essential to the proper and economical organization and prosecution of its work. At the same time, so long as the Governor could not appoint the major part of the commission and the same being non-paid, there would be no inducement at any time to make the position one of political preferment.

The duty of such a State Highway Commission should be to consider at its meeting all questions relating to the general policy of the State Highway Department, the conduct of the work in general and the annual report of the State Highway Engineer. It should act for the Department in all matters relating to recommendations, estimates and appropriations which may be submitted to the Governor.

The actual work of the State Highway Department should be under the direction of one man appointed by the commission and possessing technical qualifications, experience and ability. The State Highway Commission should therefore be authorized to appoint a State Highway Engineer and fix his salary and the law should provide that he should be a civil engineer, skilled and experienced in road construction and maintenance.

The State Highway Engineer should be empowered to appoint all his assistants with the advice and consent of the Commission and under such civil service regulations as may be in use for similar positions in other departments. The State Highway Engineer should in fact be given full authority in all executive work of the State Highway Department including the receiving of bids, the awarding of contracts and the supervision of the work of construction and maintenance.

WHAT GOOD ROADS MEAN TO RAILROADS

By Walter B. Thomson.

The fact that the railroad is simply an extension and amplification of the public road makes this question a very interesting one to discuss; and the railroad is so absolutely dependent upon the public road that no railroad management can afford to neglect this relationship.

The Roman maxim is "The first step in civilization is to make roads," and the application of this maxim to our country is evidenced by the fact that as early as 1673 the first post riders made trips between New York and Boston. Conditions slowly improved until the demand for better means of transportation became so marked that we find records of the act incorporating the Philadelphia and Lancaster turnpike, providing for the levying of tolls, on April 9th, 1792; length 62¼ miles, capital $360,000.00. In 1822 we find about 1,800 miles of turnpike completed and 700 more miles chartered. The first line of the old National road came in 1818, and was 130 miles long and cost $1,700,000.00.

About this time water transportation, which had been a large factor, was materially aided by the canals; and, as evidencing the effect of good transportation facilities upon the growth of civilization may be cited the story of the young student in geography, who said to his teacher that "it was a wise provision of nature that the large rivers ran by all the large cities."

Shortly after this period the railroad appeared on the scene; and in 1837 could haul one ton one mile for 7 1-3 cents, as compared with a charge of about 17 cents per ton per mile on the old Cumberland turnpike. The result of this difference was a neglect of the public roads and the rapid expansion of the railroads, until at the present time the railroads are glad to haul freight for one cent per ton per mile, while our good friends from Washington will tell us that the average cost of hauling on the country roads of the United States is 23 cents per ton per mile, and the average haul is about 9 miles, which, reduced to concrete figures, shows that in 1905-1906 wheat, the transportation of which from the farm to the railroad, cost the farmer 5 4-10 cents per bushel, could be shipped from New York to Liverpool, a distance of 3,100 miles, for 3 8-10 cents per bushel.

What have the railroads done since 1837 and why? One example near home will suffice: Since the original building of the Pennsylvania Railroad between Harrisburg and Philadelphia 13 full circles of curvature have been removed and the grades have been reduced, by changes of line and the building of freight lines, until now the ruling grade against the loaded movement is .3 per cent. compensated, and only a very small portion of the railroad is on its original bed; and the cost of the change and additions ran away up into millions. All of these millions were spent to increase the number of tons hauled by a given unit of power, either by heavier trains or by greater speeds, with the result that the rates have been decreased as I have just stated without any decrease in the returns on the capital invested. The same line of work on the public road will unquestionably bring the same result and the same return.

To answer the question under discussion, namely, "What Good Roads Mean to Railroads," and bearing in mind that the railroad and the public road are equally in the transportation system of the country, let us consider briefly the benefits of good roads to the community. Good roads will enable the farmer to haul his produce to the market at all times, instead of when the roads are passable, and, it is estimated, will reduce the cost of this hauling by one-half, besides enabling him to choose his market conditions. It will enable him to haul the produce from a much greater distance to a given market, as the farmer hauls by time and not by distance. These advantages have the practical effect of enlarging the territory of any given market, and of allowing the farmers further away to diversify their products and make more money. When the farmer is prosperous the market town is likewise, because he spends more money, and the entire community is benefited.

"One of the most remarkable instances of the value of good roads was shown by the history of the good roads movement in Bradley County, Tennessee. This is a small county, only having 325 square miles of area, and a population in 1900 of about 16,000. The average assessed valuation of the land was a fraction over $9 per acre, and the total tax rate about $1.65 per $100 A good roads movement was begun, and those in favor of good roads proposed an issue of $90,000 in bonds. There was a long and bitter fight against the movement, the opponents claiming, as usual, the poverty of their county, and inability to pay any addition to their present rate of taxation. After various discouragements and strong opposition, the good roads people finally succeeded in securing a small majority in the vote for issuing these bonds. Obstacles were still thrown in their way, and it was some time before the Court confirmed and ordered the issue and sale of the bonds. The good roads people, who secured the control of the expenditure of the funds, began their work in a thoroughly practical, systematic manner. They first secured a highway engineer, well qualified by education and experience, to take charge of the work of laying out and constructing the roads, and purchased modern road making machinery. The work was well done and the advantages of a turnpike road became so apparent that before one-half the money had been expended there was a clamor from all parts of the county for an additional appropriation sufficient to extend the good roads system to all parts of the county. As a result, the people almost unanimously voted a total appropriation of $186,000 of good roads bonds, and these were sold for the sum of $210,000. To-day Bradley County has 153 miles of as fine turnpike roads as can be found anywhere, and Cleveland, the county seat, is growing rapidly in population and importance as a manufacturing town. Lands that went begging along the old mud roads at $8 and $10 per acre are now finding ready purchasers at from $15 to $30 per acre."

The business of the railroad is the manufacture and sale of transportation, which is a very perishable commodity, since unless it is used when manufactured it is wasted. Now let us apply the good roads to the railroad serving the community, which I mentioned a few minutes ago. First, as a general proposition the prosperity of the community is directly reflected in the earnings of its railroad station. If the people in the community get more money they buy more goods and start local industries which help the freight earnings; they travel, and that helps the passenger side of the business. Second, if the farmer can haul at all seasons of the year, and does not have to wait for road conditions, the management can depend on a certain fixed business, and very much less of the perishable commodity manufactured by it is wasted. Cars are loaded and unloaded more promptly, so that fewer cars are needed; package freight is handled more promptly, so that the warehouses need not be so large, and discussion on that very unpleasant subject of car demurrage and storage charges are avoided and the agent kept on better terms with his shippers. Third, if the farmer can haul his produce from a greater distance and diversify his crops, the railroad will get more freight to haul, and the higher grades, such as small fruits, etc., will carry a higher rate for a given tonnage.

These are the practical dollar and cents reasons why the railroads want good roads, but there is another reason, which, while it is not directly a matter of money, is one of vast importance to the community at large: About four years ago the Pennsylvania Railroad Company by compiling statistics found that an average of almost three trespassers for east business were killed on its lines. Understand, I do not mean by road crossing accidents or by accidents caused by the persons being on that part of the property of the Company where they had a legal right to be, but caused by persons walking on the tracks in preference to the public roads, because of the condition of the roads or because the distance to be covered was shorter by the tracks. To prevent this appalling economic waste a campaign was inaugurated by the Company to stop the practice. Items and statistics were prepared for the newspapers, who have helped wonderfully; at many points lectures were given to school children and others; employes were instructed to warn people found walking on the tracks of the danger; special officers were hired, and in extreme cases arrests were made in the States where the laws permitted; with the result that our latest reports show that the average has decreased to two per day.

As illustrating the bearing that good roads have on this dreadful waste, one of our Superintendents, who is located in the State of Pennsylvania, told me a few days ago that the pastor of one of the churches along the division of which he has charge sent him a petition asking that a certain portion of the track be allowed to remain open to the public, because for a large portion of the year it was the only way the majority of his people could go to church by reason of the condition of the roads.

It is felt that with good roads the number of trespassers killed will be reduced to a minimum; and I wish to add this as an additional and very important reason.

As evidencing the fact that the railroads in general are fully alive to the situation, the following names are to be found among the directors of the recently formed American Association for Highway Improvement, of which Mr. Logan Waller Page, Director of the United States Office of Public Roads, is President: Mr. W. C. Brown, President of the New York Central; Mr. Louis W. Hill, President of the Great Northern; B. F. Yoakum, Chairman of the Frisco Lines; James McCrea, President of the Pennsylvania Railroad; W. W. Finley, President of the Southern Railway. Nine other gentlemen of national reputation and from almost every walk in life compose the balance of the Board and it is felt that this Association has a career of great usefulness before it.

About three years ago the management of the Pennsylvania Railroad decided to assist actively in the "good roads" movement and feeling that as there were approximately 96,000 miles of dirt roads in this State a large percentage of which would have to be maintained for many years to come, as dirt roads, they employed D. Ward King, the patentee of the King Split Log Drag and a dirt roads expert to deliver a series of lectures on the building and maintaining of dirt roads.

Mr. King lectured to meetings which were held at Lancaster, Millersburg, Sunbury, Milton, Williamsport and Corry, and preached the gospel of the Split Log Drag and the little and often method of road maintenance.

Meetings of station agents and other employes were held at the various division headquarters and the agents were sent home to their stations to become missionaries in the cause.

Meetings were held at numerous points in the state and lectures given by employes of the Company who had studied the subject and a lecturer was sent to any county or Grange meeting upon application to the local superintendent.

Split Log Drags were built and given to the local highway officers at many points and a pamphlet by D. Ward King entitled "Good Roads at Low Cost" was furnished to all station agents and by them distributed to all persons interested.

On January 25th a "Good Roads Educational Train" was started at this city and will cover the entire mileage of the P. R. R. within the State. This train is in charge of Pennsylvania State College, co-operating with the Office of Public Roads of the National Government, the Pennsylvania State Highway Department and the Pennsylvania Railroad, and is composed of two car loads of road building machinery, one car containing the United States exhibit of road models and photographs and one car in which stereopticon lectures are given at each stop. The train stops at practically all the villages on its route and night lectures are given at all large towns. If the present rate of attendance keeps up, 100,000 people will visit it in the six or seven weeks it will run.

This is, I think, the first "Good Roads" train run by any eastern railroad, and, Gentlemen, let us congratulate ourselves that it's being run by the Pennsylvania State College, the Pennsylvania Highway Department, and the Pennsylvania Railroad, all good Pennsylvania institutions and that our good friends at Washington think enough of us to give us their invaluable assistance.

I have tried to answer the question given me for discussion and also to show that the railroads in general and the P. R. R. in particular are fully alive to the benefits to be derived from "Good Roads," but I cannot close without a quotation from an article written by one of the gentlemen who is with us this evening, which seems to me to sum up the matter perfectly:

"There is no phase of life in the country, social or economic, which is not affected by good roads. There is a direct relation between improved highways and the value of land, the attendance of children at school, the health of the community and everything else that tends to make life in the country efficient. And this in turn affects the people in the cities who live on country products. It is a task—the maintenance of good roads—which affects every person in the country, no matter where he lives or what his profession."

THE ECONOMICAL MAINTENANCE OF DIRT ROADS

By WALTER B. THOMSON.*

In this discussion we will leave out of the question entirely the construction and maintenance of the expensive macadam and brick roads, and confine ourselves to the construction and maintenance of the dirt roads, the object being to determine whether by the adoption of improved methods we cannot get better roads than we now have for less money than we are now spending. We are taking the subject from this point of view because in this country it will be absolutely impossible for us to replace a large proposition of our dirt roads with the more expensive forms of construction for a great many years to come.

Statistics show that in 1840 a team could haul one ton per mile at a cost of about seventeen cents, while the railroads could do the same work for about seven and one-third cents. At pres-present time it costs from twenty to twenty-five cents per ton per mile to haul with horses, while the railroads can do the same work for one cent per ton per mile. Since 1840 there has been a tremendous amount of energy and ability devoted to the improvement of the railroads, while until a very few years ago, the public roads were very badly neglected. The best figures available show that there is spent in the United States about $38.00 per mile per year on the public roads, and while this amount is very much less than what is spent in the European countries, there is no question in my mind but that were it properly expended our roads would be very much better than they are at the present time.

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There are two very essential factors that go to make up the proper care of dirt roads: The first is a money tax, instead of a road work tax. It has been very truly said that a man might as well teach out his school tax as to work out his road tax. The road tax should be collected in cash, so that the road work can be done by men who are hired and paid cash, just as is done in any other well regulated business. The second factor is the method of doing the work. Under the old method all the road work is done in the Spring and early Summer, and is usually done by the use of a big grader or road machine, which tears the top off and piles a large quantity of soft material in the center of the road in an effort to crown it properly. This soft earth will not stay in position and the roads are bad immediately after being worked, but after being driven for a time become fairly passable. This condition does not continue, however, because there is no particular attention given to them until the following Spring, so that if mud holes form they simply grow worse until the road machine makes its next trip in the following year. Spring finds the roads low in the center and very muddy, and the fact that the top of the road is soft has caused the water to soak into it to almost any depth, and as a consequence the hauling is very bad.

Let us substitute for this method the more modern one, namely, the equipping of each township with one King Split Log Drag for every six miles of road, and locate this drag with a farmer who is conveniently situated, so that he can drag his six miles of road when called upon to do so by the supervisor. Beginning in the Spring, when the frost is coming out and the road is muddy and not yet deep, it should be dragged. The drag pushes the loose earth alongside the road and the mud from the wagon tracks toward the center. The drag acts like a plane, only that in addition to shaving off the high places, it fills the low places with the shavings. During the first Spring a large amount of earth is moved toward the center of the road with each dragging, because the earth is loose and soft, owing to the lack of surface drainage. After the road has been dragged a few times it will be found that it dries up much faster than after the break-up in former years. If this method is continued during the year, and the road is dragged every time the top of it becomes soft, the road will become properly crowned, and the material will become compact or puddled, so that the surface will turn water;

and after one season of dragging it will be found that there is very little break-up in the following Spring. This method carried out for a year or two will bring any road which is composed of a material which has even a small percentage of clay in it into such a condition that it can be maintained by the drag at an expense of not over $5.00 to $7.00 per year, figuring the cost of dragging the road at thirty cents per hour for the team and driver. There are some sections where the drag will not seem to work properly, because the material in the road itself is sandy and will not stick together and puddle. This is very readily overcome by the addition of a little clay soil to the top of the road.

The great distinction between the two methods of road building referred to is that under the old method all the road work is done within sixty or ninety days, and that for the rest of the year the road must take care of itself; whereas, under the new method, the road is given constant attention.

The King Split Log Drag, which is the tool suggested for this work, can be built by any carpenter at a cost not to exceed $5.00, and is thoroughly described in Farmers Bulletin No. 321, of the United States Department of Agriculture, which can be had by any one upon request to the Department of Agriculture at Washington. The drag is the invention of D. Ward King, of Holt County, Missouri, who had it patented and threw it open to the use of any man who will build one. Mr. King is a Good Roads expert, and has been wonderfully successful in the development of a method for properly caring for dirt roads. The drag is in very general use in the West and in many of the Eastern States, and is making good dirt roads at a very low cost wherever it is used intelligently.

As to costs, a careful estimate of the cost of maintaining dirt roads under the old road work tax system shows that the maintenance of a mile of road per year averages from $30.00 to $40.00, whereas with the cash tax and the drags the road can be kept in infinitely better shape for from $5.00 to $7.00 per mile, and the cost will decrease slightly the longer the road is dragged. The explanation for this is that the drag does not tear up the surface of the road, but simply obliterates the wheel tracks and ruts and smears in the mud so that it is baked hard by the next sunshine. A section of a dragged road, if carefully cut down, will show an infinite number of layers of mud which have been smeared on, and baked, each one adding to the strength of the roadbed and adding to its capacity to turn water, or drainage; and, after all, the one essential element in good dirt roads is perfect surface drainage. Under drains and cross drains are, of course, important, but surface drainage affects every foot of road, and if you have a well surface drained road it is a good road. Our present tendency is to condemn the dirt road as a failure, and to rush blindly into the macadam or brick, costing from $5,000.00 to $15,000.00 per mile, without determining by careful investigation whether or not the dirt road will carry the traffic which comes upon it if it is worked scientifically and economically. The result of this is that in the case of the macadam or stone roads the maintenance costs will be increased enormously, as I do not believe that a stone road can be maintained for less than $150.00 per year per mile. While I am absolutely in favor of stone roads or brick roads where the traffic renders such improvement necessary, I feel that it is a very serious waste of money to build a stone road to carry the traffic which can be readily handled by a dirt road if it is given a proper chance. My argument is that we have never given the dirt roads this chance, and that until each particular piece of road has been carefully maintained and worked as a dirt road for a given period, no one can say absolutely that the stone road is a necessity. I am heartily in favor of the macadam and other forms of improved roads, but am today making a plea for the poor old dirt road, which, up to a given density of traffic, is the best road that can be made, and which has never really had a chance to show what it will do if properly maintained.

BEGINNING OF THE GOOD ROADS MOVEMENT

BY HON. FRANK D. LYON.*

As a result of a few years agitation on the part of good roads enthusiasts of the State of New York prior to 1898, there were two laws placed upon the statute books of the state in that year, one of which was known as the Higbee-Armstrong act, which provided for the construction of so-called state roads to be paid for, 50% by the state, 35% by the county and 15% by the town or towns, in which such highway was to be constructed.

The other was known as the Fuller-Plank act, which provided for state aid to towns, which, of their own volition, adopted the money system of working their highways.

During the two or three years following 1898, the state highway work under the supervision and direction of the State Engineer and Surveyor, was purely experimental, appropriations on the part of the state were small and the mileage constructed extremely light.

Bond Issue and Percentage Basis of State Aid

Owing to the fact that the constitution of that state prohibited an expenditure of a sufficient amount of money to meet the requirements of the various counties, it was subsequently deemed expedient to submit a proposition to the people to bond the state for fifty millions of dollars in order to render available sufficient funds to meet the demands of the counties.

In the meantime those counties which had adopted the money system were dissatisfied with the operations of the law and the amount of state aid they were entitled to receive. This law was subsequently amended, basing the state aid to towns upon the assessed valuation per mile so that the rich towns might receive fifty cents on each dollar of tax raised and the poorer towns, according to their assessed valuation, might receive sixty, seventy, eighty, ninety cents or a dollar for each dollar of tax raised.

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After the question of bonding the state had been submitted to a vote of the people, it became apparent to those who were interested in this movement that the highway work of the state could not be successfully carried on by the State Engineer and Surveyor, owing to the vast amount of other interests under his jurisdiction, such as the construction of the barge canal, etc., and it was deemed advisable to create a separate department.

Appointment of Revision Committee and Enactment of Law

A joint legislative committee was appointed for the purpose of recodifying the highway laws of the state and to make such recommendations to the legislature for its approval or adoption as might seem expedient or proper. As a result of the labor of the joint highway committee thus appointed, with which committee I served in the capacity of clerk, the present existing highway law was formulated and enacted.

That law provided for several radical changes, one of which was for the construction of state highways at the sole expense of the state, and another providing that all the towns of the state should be placed upon a money system basis. This, however, was not done until three-quarters of the towns of the state had, of their own volition, adopted the money system.

The legislative committee in making its recommendations and in submitting a proper bill for enactment had uppermost in mind the fact that the total number of miles of highways in the state was approximately eighty thousand miles, and that the law should be so comprehensive as to provide that each and every mile of the public highways of the entire 80,000 miles should ultimately receive proper care and attention according to the amount of traffic such highways were called upon to carry.

Organization of Highway Department

The highway law as it now stands provides:

That a state commission of highways consisting of three members, one of whom must be a practical civil engineer, be appointed by the Governor, and the commission itself is empowered to appoint a secretary, two deputies, engineers, clerks, officers and employes such as may be necessary to carry out the provisions of the act, excepting such officers as the law specifically provides for, who are either elected by the towns or appointed by the various boards of supervisors.

Classification of Highways

It is not necessary that I should go into details regarding the organization of forces in order to carry on this work, suffice it to say that the highway work of the state is divided into three classes:

First.—Construction of state and county highways.
Second.—Maintenance of such highways thus constructed.
Third.—The improvement, repair and maintenance of town highways and bridges.

You will, therefore, notice that there are three classifications which might properly be described as highways of the first, second and third class; first class roads being those which are known as state highways, built at the sole expense of the state, without any contribution on the part of the counties and towns through which such highways may pass. This system of state highways consists of about 3,000 miles of so-called main freight roads leading to and connecting the principal centers of population. The second class roads are known as county highways, which are built at the joint expense of the state, county and towns in which they may be located, being the main market roads within the county, and the location of which is determined by the local county authorities. These highways are usually designed as feeders to the trunk lines, or connecting portions of the trunk lines with other county highways or county highways with each other. These highways are designed to consist of about 6,000 miles. The third, the town highways, embrace about 71,000 miles of road, or will when the entire system of highway work is completed, and includes all roads lying outside of cities or incorporated villages, and not included in the classes just mentioned and which are repaired and improved in accordance with the rules and regulations prescribed by the commission.

Organization of Construction Department

For the purpose of constructing state and county highways the state is divided into six divisions, each in charge of a division engineer, who is responsible directly to the engineering member of the commission. These six division engineers are held accountable for the work performed and to be performed in their respective divisions, subject, of course, to such rules and regulations as may be prescribed for the purpose of standardizing, etc.

These divisions are made as nearly equal as possible and are arranged in accordance with the various local conditions, so that in each division the division engineer may be required to become thoroughly familiar with the character and ocnditions of the soil and the local material to be used for road building purposes, etc.

The plans, specifications and estimates are prepared by such division engineers, subject to the approval of the commission, and, of course, through their assistants, have jurisdiction over all work performed by contractors.

Apportionment of Mileage of State Highways

In the apportionment of the so-called state highways, that is the 3,000 miles heretofore alluded to, it is provided that there shall be an equitable distribution of such mileage to the various counties of the state ,in accordance with the mileage therein, and, excepting in case of special legislative enactment, no state highways can be constructed except along the lines of such equitable apportionment.

This same apportionment applies to the construction of county highways, but, owing to the fact that the counties and towns are called upon to contribute toward the expense of construction of such highways, you will notice that it is expected that double the amount of so-called county highways can be constructed each year in each county, to that constructed and known as a state highway.

Choice as to Class of County Highway Construction

There is no diversity of opinion in the State of New York as regards the class of construction of so-called state highways, but to-day there is a diversity of opinion as regards the construction of the so-called county highways in that the statute provides for an equitable distribution on the basis of mileage rather than the equitable distribution on the basis of dollars and cents; and on account of the fact that the statute is not broad enough or comprehensive enough in that particular so as to enable the various localities to elect as to the kind and class of construction that is most needed in building these so-called secondary highways. The equitable apportionment on the basis of mileage, you will notice, carries the conclusion to the local county authorities that inasmuch as they are entitled only to so many miles of road on the basis of such apportionment, it is therefore up to them to demand a more expensive construction than local requirements actually call for and there is no incentive on the part of the locality to demand, say, two miles of five thousand dollar road as against a single mile of ten thousand dollar road. The law providing for county highways in the State of New York, in my opinion, should be amended so as to provide a permissive plan or a choice as between a contract system and a system of construction by the employment of their local labor under the supervision and direction of the town superintendent, directed by the county superintendent in accordance with the rules and regulations prescribed by the commission and not in accordance with plans and specifications which necessarily must be provided in case of the contract system.

Duties of First Deputy: Maintenance

The law provides that the first deputy appointed by the commission, shall give his entire time and attention to the maintenance of improved state and county highways, and this question of maintenance is a serious one for your consideration; it has been so in New York State and is so to-day.

A patrol system, similar to that in France has been established and has proven to be very efficacious, but we realize that taking into consideration the highways that have been constructed since 1900 and which have received practically no care or attention up to the establishment of this commission, that a systematic plan of maintenance must be provided for by statute in any state contemplating highway improvement of the character that is uppermost in your minds here to-day.

Personal Study and Experience: Development of Plan

For sixteen years I have given the subject of highway improvement careful thought and study, not only from a theoretical standpoint, but from actual practice and demonstration, and I have arrived at the conclusion that the greatest obstacle to be surmounted in the conduct of an undertaking of a character that you are considering to-day is the fact that there are but very few persons in any state who have a thorough knowledge of road construction of any character which is gained from practical experience, and we all know that "practice makes perfect."

It is my judgment, based on practical experience, that no state in the union can devise a plan that will be successful, or a plan by which desired results may be attained, excepting their plan for such purpose is so comprehensive and so broad that it will tend to complete a vast organization built up by active interest on the part of the local authorities and covering every section, no matter how small it may be. You cannot hope to successfully undertake to line up a system of highway improvement for the State of Pennsylvania in the interests of the automobilists alone; you must bear in mind that highway improvement is for the express purpose of increasing the value of the taxable assets in your state, and you must take into consideration in this question the development and improvement of the landed interests of your state.

Support of Rural Population Necessary to Success of Scheme

In the State of New York we would not have attained the results which we have to-day had it not been for the active interest and support of the New York State Grange, representing the farmers and taxpayers throughout the rural communities, whose vast membership to-day numbering over one hundred thousand, is interested in the plan as inaugurated in our state.

Roads Develop Autos, Not Autos the Roads

It has been erroneously stated in the press of this country, that the improvement of the public thoroughfares in my own and other states is the result of agitation and the result of demands on the part of the users of the motor vehicles, when, as a matter of fact, the good roads laws of the State of New York, were placed upon the statute books of that state prior to the advent of the automobile, and our primary work had been commenced and the work had been started before one single license had been issued in the state, and the first roads were built without any reference to motor vehicle traffic or the problems which it presents. The improved condition of the highways in the State of New York has developed the automobile and the automobile interests, but the automobile interests have not develped the highways. The agitation for highway improvement in our state was for the express purpose of enabling the farmers to deliver their produce from the farm to the local markets at a minimum cost—that is, the interest of the farming communities of our state.

Pennsylvania Plan

Your plan is a good one, and so far as it goes or so far as I am able to comprehend it, I would state that in many respects your plan is perhaps superior to that of my own state, but, in the recodification of your laws so far as I am able to ascertain, you have neglected to provide for those interests most vitally in need of highway improvement and vitally necessary to the success of any scheme of this character.

You have, in the State of Pennsylvania, about the same mileage as we have in New York, viz. 80,000 miles of public highways, and it would be a crime, in my judgment, to devote your entire attention to the improvement of simply the main roads leading to and connecting your principal centers of population. Therefore, I am prompted to perhaps impose upon you by giving you an idea as to how we have met the situation in the State of New York, and that class of work comes directly under my supervision and control as a deputy in onr State Highway Commission.

Bureau of Town Highways: Organization

I have recognized the fact in the work of the bureau of town highways that organization is the watchword, and in the organization of that bureau the state has been divided into ten districts and a district supervisor appointed to supervise the highway work in the district to which he is assigned; to have general supervision of the highway and bridge work of his district, giving advice and instructions to the local authorities and to see to it that the rules and regulations as prescribed by the commission are carefully carried out, the auditing of highway accounts and such other work as he may be directed to perform. These district supervisors were selected because of their particular and peculiar adaptibility to work of that character, without regard to a technical education but a practical training was uppermost in my mind in the selection of these men.

The state is again subdivided into 57 counties, each in charge of a county superintendent of highways, each of whom was appointed by his board of supervisors from an eligible list prepared by the State Civil Service Commission, the salary and expense of the county superintendent being a county charge and fixed by the board of supervisors of each county. In the preparation of this eligible list by the civil service commission again it was not deemed expedient that such an officer should have a technical education, but that he should be a practical road builder, and results have proved conclusively the wisdom of this course.

The state is again subdivided into 934 towns, each under the supervision and direction of a town superintendent of highways elected by the people of the towns, and, generally speaking, these officers are interested in their work and are putting forth their best endeavors to carry on highway improvement in their respective towns in accordance with the standards provided for under the rules and regulations of the commission. Many of these two superintendents have proven themselves to be experts in the construction of culverts and short span bridges. The supervisor of these towns is the custodian of funds applicable to town highway work. The members of the town boards, seven in number, are also required to perform certain duties and as a result you will notice that in the organization of the bureau of town highways we have the active interest and support of about 7,000 local officers scattered over the entire state.

I might go into detail and give you a comprehensive idea as to the duties of town superintendents in preparing their estimates upon which state aid is based, the duties of the town officials in the collection of funds and in the disbursement of the same, but I hardly think it would be wise so to do in a meeting of this character.

Work Accomplished by Bureau of Town Highways

Suffice it to say that during the last few years in the improvement, repair and maintenance of the public highways of the State of New York the public, through the press, has had its attention drawn more particularly to the construction of state and county highways, involving the expenditure of the fifty million of dollars made available by our bond issue, and but little publicity has been given to the fact that the improvement, repair and maintenance of town highways and bridges is of as much importance, if not greater, in the development of our state's assets, than that derived from the more expensive roads within the state. Up to January 1, 1911, under the supervision and care of the State Engineer and Surveyor and later on under the supervision and direction of the State Highway Commission, there was constructed 2800 miles of state and county highways, involving a total expenditure of $28,000,000. During the year 1910, under the supervision and direction of the State Highway Commission, there was constructed about 400 miles of state and county highways, at an approximate cost of $4,800,000. During the same year there was expended by the state and the towns for highways and bridge improvement, the sum of $6,405,000. 391 miles of macadam road were constructed of a character suitable to local conditions and sufficient for the traffic needs of the road so built, at costs varying from $800 to $3,000 per mile. But, you must bear in mind the fact that in the construction of these town macadam roads, the local authorities had the active co-operation, support and interest of the farmers of the community in which such road was built, to the extent that "bees" were formed, services were given gratuitously, material furnished without cost and delivered to the crusher, etc., thus reducing very materially the cost of such construction and which could have been secured in no other way possible and under no other system. During the same year about 1,300 miles of gravel roads were constructed by the towns of a character to stand the local traffic, and varying in cost according to the availability of the material and the character of the soil where such roads were built. And, still further, during the same year over 20,000 miles of the 80,000 miles of the state were shaped, crowned and standardized as to width, 24 feet between ditches, with safety ditches, guard rails, etc., and I have only to say to you, gentlemen, now that my experience has taught me the fact that there is no road on the face of the earth any better than an earth road when the earth road is good. There is no other road on the face of this green earth so pleasant for man or beast, with or by the use of a vehicle of any kind to travel over, when that road is in good condition. Many miles of earth road in the State of New York that in years gone by have been looked upon as incapable of permanent improvement without the addition of foreign material, as a result of state sanndards adopted in the way of sub-drainage, proper crowning and proper attention in the way of honing at frequent intervals, have been put into first class and acceptable condition.

Proper Use of Machinery

I desire to call particular attention to the misuse or misconception as to the use of proper machinery in the improvement of town highways, and would not care to convey the impression that I am antagonistic or that I would not advise the construction of macadam roads by towns, yet I want to impress upon your minds thoroughly the fact that in some of the counties of the State of New York, the greatest obstacle we have had to surmount, is the so-called "crusher-craze." We are laying down in that state an inflexible rule that towns shall not be encouraged or permitted to use funds in which the state has an interest, either directly or indirectly, in the construction of short stretches and patches of macadam highways, excepting that all of the highways of the town in which such improvement is to be made shall have first received proper primary attention in the way of shaping and crowning and proper drainage, culverts, etc., and that the portion proposed to be improved shall bear some relation to some other portion either already improved or to be subsequently improved.

There is no doubt of the practicability and economy of a town or a county constructing macadam roads under proper circumstances, and they are urged so to do, but only when either the town roads as a whole have previously received proper attention, or that the town authorities have provided a special fund sufficiently great to enable them to carry on this class of work independent of general primary improvement. It is a serious mistake to progress work of this character unless the town is in possession of a power roller. While crushed stone roads have been built without the use of the roller, depending upon the traffic to compact the stone, it is an expensive way to accomplish the result and is extremely annoying to the traffic for a period of weeks and sometimes months.

New York System the Result of Years of Agitation and Work

Perhaps you gentlemen may not deem it expedient or wise to undertake a project of this character with one fell swoop, because of the fact that the system as inaugurated in the State of New York is the result of years of agitation and years of hard work to overcome local antagonisms, and that, of course, you will have to look for in this state the same as we had it in New York. However, you have New York State as a guide as to results in this matter and I submit that this is a question worthy of your careful consideration.

THE GOOD ROADS TRAIN

By John Price Jackson.*

John Price Jackson, Dean of the School of Engineering of the Pennsylvania State College, spoke upon the purpose and organization of the Good Roads Train. He said in part:

The purpose of the Good Goads Train is two-fold: First to urge the progressive citizens of the Commonwealth to aid in promoting the adoption of more efficient methods of expending the local township road taxes; and, second, to gain support for more efficient and business like road legislation such as that contained in the admirable proposals of Senator Sproul and his associates As the train has already met over fifty thousand of the people of Pennsylvania and will increase that number to close to one hundred thousand before its itinerary is ended, its influence in advancing those worthy projects is, I believe, of quite considerable value. This statement appears to be true from the great enthusiasm which has greeted the train at nearly every stop which it has made.

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*Dean of College of Engineering, Pa. State College.

Consider for a moment the second object of the train, namely, legislation; the speakers on the train emphasize the following five points, all of which, with the exception of the fourth, are satisfactorily embodied in the Sproul-Thompson bills:

First. That a system of state roads, built entirely at the expense of the state be laid out, in which the greatest production possible will be connected with its markets at the least possible expenditure, not neglecting the requirements of through traffic.

Second. That the state take over the maintenance of all state-made highways at once, thus preventing the rapid deterioration of the roads at present built, and those to be built, which is now occurring, with resultant enormous loss to the commonwealth annually.

Third. That the Highway Department be increased in its engineering force to such an extent that the services and direction of a competent road building engineer can be made available for the supervision of the work of construction and maintenance of every mile of the highways of the Commonwealth, whether of the secondary or township class, or of the state-built variety; also that this department be given power to enforce the adoption of proper methods.

Fourth. That such bonuses, remittance of taxes, or other incentive be granted to the users of broad tires, that it will be to the advantage of those hauling heavy loads to obtain broad-tired wagons. This proposition is based on the simple, well known fact, that the narrow tire is most injurious under heavy load upon the road, while the broad tire is apt to improve the road, thus saving to the commonwealth a large proportion of its investment in highways.

Fifth. That the burden of the rural roads upon the rural communities is greater than they can bear under the present conditions of long distance travel occasioned by the automobile and otherwise, and therefore, that a more efficient method should be adopted for aiding the rural districts, in constructing and maintaining their secondary roads; such aid from the state being made, however, in a manner that the local community will be made to bear its fair proportionate share of the burden and will have no alternative but to use proper methods.

In regard to the first object of the train, namely the proper use of the local taxes, it is first explained that of the enormous sums expended in the form of local taxes during the past twenty-five years but little remains in the form of permanent road investment, while had this local money been properly used a property worth several tens of millions would now be available to the uses of the state. The causes of this past waste are explained to be due to the "work tax," the use of hand labor, the lack of water proof road surfaces, uncrowned roadbeds, poor drainage, bad location, unsubstantial bridges, etc.

Having thus presented the subject of past wastefulness, and also having dwelt in full upon the actual value to a community of good roads, the lecturers hammer hard upon six topics for increasing efficiency in the expenditure of local taxes with a resultant large improvement in the roads at no greater cost than heretofore, as follows:

1. The abolition of expensive human labor by the substitution of horse and fuel power through the medium of machinery and more especially by the use of the road drag (dwelt upon by Mr. Thompson.)
2. The making of hard, crowned surfaces and dry foundations to the roads by the puddling action of the drag where usable, by mixing sand with clay, and, where crushed stone is used, by the use of the roller and sprinkler (a home made, inexpensive, concrete roller is shown in the exhibit).
3. The possibility of removing most of the water "breakers" where the road surface is properly crowned and water proof.
4. The substitution of culverts for water breakers, where the water must be carried from one side of the road to the other, (a collapsible, resuable form for making inexpensive but durable concrete culverts is shown in the exhibit.)
5. Simple methods of drainage for the ordinary conditions apt to be met with.
6. The economy in building substantial bridges (The State Highway Department will furnish plans for bridges and culverts free of expense to the township.)

The responsibility for the railroad equipment, the making of schedules, and the operation of the train was assumed by the Pennsylvania Railroad Company by the approval of President McCrea and the necessary accompanying duties were efficiently performed under the dirction of General Superintendent Creighton, his assistant, Dr. Nelson and the other general and division officials concerned. The use of the word "efficiently" at this point leads me to ask your indulgence for a moment while I digress as an engineer to say, in spite of the recent public uterance to the contrary of one of the most widely known lawyers of the United States, that I believe the railroads of this country to be in the van of the struggle for industrial efficiency—this is especially true of the Pennsylvania Railroad as will be verified by a study of the work of Mr. McCaleb in your own city. They undoubtedly adopt improved methods as rapidly as the conditions warrant, but they cannot, in view of their obligations to the people, accept the dictation of the impractical theorist until his proposition has been proved.

The educational work of this train was organized by the Engineering School of the Pennsylvania State College, upon the plan of its president, Edwin Earle Sparks, that a state institution, supported entirely by the taxes of the people, should endeavor, by such means as are possible, to bring its facilities to the people, instead of confining its work and giving information only to those who can come to it. I might add again, parenthetically, that this is part of the activity of the college called extension and that it includes the large work being done by correspondence courses, agricultural trains and teaching, the supervision of industrial schools, promotion of the use of safety devices in mines, lecture courses, etc., etc. A bill is now before the Legislature for extending and improving this most valuable work among the industrial classes. The educational work of the train has the hearty co-operation and active participation of the Pennsylvania State Highway Department and the United States Office of Roads. The State Highway Department has been well represented by Mr. J. T. Gephart and his assistants, Messrs. R. V. Haas and W. O. Bennett, while the United States Office of Roads has given valuable service through it representative, Mr. D. H. Winslow. The lecturers and demonstrators accompanying the train number from six to eight and the total number aboard, including the railroad officials and employes, varies from 14 to 20.

The running of the train is only one part of the plan of the college to co-operate with the Highway Department, it is arranging to turn its valuable testing laboratories over to Mr. Hunter for the creation of a map of tested, road making materials of the commonwealth, and also to join him in the building and study of an experimental road, built in sections that is, if the legislature supports the plan.

The exhibit occupies three cars. One containing a valuable and useful set of models and photographs from the United States office of roads and also photographs and exhibitions from the State Highway Department. Two others contain full sized road building machinery, such as are especially needed for making the township local roads.

Lectures are delivered sometimes in the lecture car, which is fitted up with a projection lantern and at other times in court houses.

As I have traveled over the state I have found a strong sentiment awakening throughout the whole population of the state in favor of activity promoting the building of roads. I have also found that though there is some criticism of present methods, that as a whole the state built highways have given comparatively little dissatisfaction. It is rather surprising that this is so considering the unsatisfactory laws under which the Highway Department has been compelled to work and is a proof of Commissioner Hunter's loyalty, integrity and devoted attention to business.

SOME HIGHWAY ENGINEERING PROBLEMS

By L. E. Boykin.*

Before the Engineers' Society of Pennsylvania and the Convention of Pennsylvania Engineers, at Harrisburg, June 2, 1910.

No other line of public improvement is receiving more attention to-day than that of improving the public highways throughout the country. For many years, practically no attention, and less consideration, was given to this question, but at present there is a strong public sentiment and a pressing demand from the commercial interests of the country which make it imperative that our public roads be improved.

One of the first problems which presents itself to the modern road builder is the correction of many of the errors of his predecessors in the matter of location, construction and maintenance. There are to-day more than 100,000 petty road officials in the United States, comparatively few of whom possess an adequate knowledge of road building. This statement is given considerable color by the fact that at the close of the year 1904, there were 2,151,000 miles of public roads in the United States, of which less than 39,000 miles were surfaced with stone, and less than 16,000 miles with gravel or other materials, and the expenditures aggregated about $80,000,000 per annum in money and labor, or about $1.05 for each inhabitant. This fact is proof conclusive that the methods of construction and maintenance and plan of expenditures in vogue are very deficient and will have to be reformed before we can hope to attain any great progress in improving our roads.

In the early settlement of our country, the colonists, through necessity, followed the Indian trails which had to some extent been originally located on paths made by the deer and the buffalo. These trails, for the most part, kept to the top of ridges or ran from one hill-top to another hill-top for natural reasons which appealed to the Indians. By keeping to the tops of ridges, dense timber, undergrowth, swamps and morasses were all avoided, making passage easier and the observation of the surrounding country better for purposes of attack or defense. The location of these roads in this manner, of course, made them subject to frequent and excessive grades, which did not, however, interfere with traffic conditions at that time as they would to-day. But as population grew and towns were established, these old trails were not changed to meet new conditions brought about by wheeled traffic, and the result is that to-day we have many miles of unnecessary roads and numerous difficult grades. When it is considered that a rise of 1 foot in 100 increases by approximately 20 pounds the amount of force required to haul a load of one ton, the question of grades becomes one not to be overlooked in road building. It is the most permanent feature in road building, and it should always be borne in mind that it is very expensive to regrade a road after it is once constructed. Great care should therefore be devoted to the question of grading.

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The general practice in America is to place the maximum grade at 5 per cent. for important roads, as a horse can move the same load for a short distance up a 5 per cent. grade that he can on a level. Another important consideration in this connection is that a macadam surface can only be maintained at great cost on steep grades. In fixing the grades, the engineer should so adjust the cuts and fills as to make the least possible waste of material and in doing this, he must not overlook the fact that most materials shrink to a great extent when taken from the cuts and placed in the fills. This shrinkage of course varies with different materials, but averages about 15 per cent. Care should be used in properly sloping cuts and fills to avoid, as far as possible, settlement of materials. A slope of not less than 1½ to 1 should be used. Care should also be taken to have the gutter grades so fixed that there will be a slope of at least six inches in each 100 feet, in order to provide ample surface drainage, which is equally as important as grading.

The selection of proper materials is another problem which the highway engineer must solve. It is not uncommon for an engineer to take up the work of road building with absolutely no knowledge of road materials. In general any stone that is to be used in road building should be tested before use. At present the usual test is for hardness, toughness, resistance to wear and binding or cementing value. Its specific gravity, weight per cubic foot and water absorbed are also determined. With such data as this in hand and a knowledge of the volume and character of traffic to which a road is to be subjected, the engineer can make an intelligent selection of the best available material. The trap rocks, or diabases, diorites and basalts in general meet the conditions where macadam roads are necessary, but it is unwise to select a rock by its species alone, as they all vary greatly. Every highway engineer should, therefore, have at least an elementary knowledge of geology and of testing stones for road building purposes in order that he may make a wise selection of materials to be used.

Modern traffic conditions are such that the building of practically dustless roads in the vicinity of all great centres of commerce and population is essential. This involves the general use of bituminous and other binders and presents one of the problems with which modern highway engineers have to deal and with reference to which they should be thoroughly posted.

Various experiments have been conducted with a view to solving this problem. The first experiments conducted in a scientific way were at Jackson, Tennessee, by the Office of Public Roads, during the spring and summer of 1905. The materials used in these experiments were crude and residual semi-asphaltic petroleums and a dehydrated coke-oven tar. These materials were applied to sections of the road surface for the purpose of laying dust and of binding the stone particles together. The results obtained were in every way satisfactory, insofar as the laying of the dust was concerned, the road being rendered practically dustless for a considerable length of time by means of a single application of from 0.3 to 0.5 gallon of bitumen per square yard of road surface. Considerable differences were, however, observed in the binding value of the different materials, the oil residuums and tar proving better in this respect than the crude petroleums.

In 1908, an inspection of these experimental sections showed that where the traffic was only moderate, the roads treated with the residual oils and tars were in excellent condition. The dust formation from the road material proper had been appreciably lessened, and in one instance, where a second application of tar had been made in 1906, the road was practically dustless. An inspection made in January, 1909, showed that most of the binder had disappeared from the surface of the roads, except the one which had received two applications of tar. Deterioration had, however, been greatly lessened as compared with similar untreated roads, and as late as December, 1909, the beneficial effects of this treatment were still evident.

Other experiments were conducted in the summer of 1907 at Wayland, Massachusetts, in co-operation with the Massachusetts Highway Commission. The object of these experiments was a study of the suitability of the various tars for surface treatment of macadam roads. The materials used were a crude water-gas tar, a crude gas-house coal tar and a fluid refined tar preparation, which were applied in a variety of ways upon a road subjected to exceedingly severe traffic conditions. In November of that year all of the treated sections of the road were in good condition and practically dustless. The winters of Massachusetts are usually very severe and injurious to roads. After passing through a hard winter and a second summer, another inspection was made and it was found that the sections treated with refined tar were in a much better state of preservation than those sections treated with crude products. In one of these experiments, where the road was first spiked up and reshaped before applying the refined tar, the results were of a more lasting character than in the other experiments. None of these sections was entirely dustless, owing to material brought in from outside sources. It would have been advisable to have retreated them during the spring of 1908, at which time a much lighter application of tar than that made during the first treatment would have duplicated the former results. A second treatment, however, was deferred until the summer of 1909, when a surface application of refined tar was made over the whole road with an English tar spraying machine under the supervision of the Massachusetts Highway Commission.

While these tests were being made at Wayland, Massachusetts, a semi-asphaltic oil emulsion was tried in the surface treatment of a section of the same macadam road, and proved very efficient as a temporary dust preventive and road binder. During the same summer, both crude and residual oils were applied to sections of a gravel and macadam road at Bowling Green, Kentucky, with results quite similar to those obtained from the use of like materials at Jackson, Tennessee. Also at Bowling Green an experiment with rock asphalt as a surfacing material in macadam road construction was tried. This was inspected in January, 1909, and the road was found in most excellent condition. When last inspected in May, 1909, it was still in fine condition with a smooth and firm surface, presenting much the same appearance as a first class asphalt city street. Here and there, however, where the thin surface coated with asphalt had worn away the crushed stone of the upper course was slightly exposed. The wearing course of stone, however, was securely bound together and presented no indication of deterioration.

The use of Calcium chloride, as a dust preventive, was also tested in 1907 at Washington, D. C. Two applications of a ten per cent. solution of the pure salt made at the rate of 0.4 gallon per square yard, laid the dust very successfully for a period of six weeks, no additional application of water being made. At the end of this period, another application was made with similar results. A total of five applications was required to lay the dust throughout the season.

These, and other experiments, have afforded considerable data in regard to the surface treatment of roads and numerous experiments are also being conducted for the purpose of determining the advisability and value of using binding materials in road construction. This is also a very important field of work and will do much towards improving the condition and the durability of roads. Reports of the results obtained will be published from time to time, together with an analysis of the materials used, and it is expected that much valuable information will be secured.

Tests are also being made with a view of determining the value of Portland Cement for road building purposes. Lime cement concrete is the oldest road material of which we have any record. It was largely used by the Romans in building their roads and the Roman roads which were constructed of this material are the only ones which have endured for any great length of time. The Appian Way, which is undoubtedly the best type of Roman road, was begun by Appius Claudius 312 B. C. and parts of it are in an excellent state of preservation to-day. Modern Portland Cements are far superior in strength and durability to the lime mortar used by the Romans, but even roads constructed to-day with Portland Cement are far from satisfactory.

Portland Cement is in some respects an almost ideal permanent road binder and especially where motor traffic only is encountered. When mixed in proper proportions with a mineral aggregate it produces a hard, rigid concrete well designed to withstand the shearing strains exerted upon it by the wheels connected with the driving mechanism of automobiles, and practically unacted upon by the large pneumatic rubber tires of such vehicles. Under steel-shod horse-drawn traffic, it is, however, far from ideal, owing to its lack of resiliency and its tendency to spall under impact and abrasion.

Investigations are now being conducted by the Office of Public Roads with a view to finding some way of overcoming these undesirable properties. The work already done would seem to indicate that certain petroleum residuums may be used to advantage in wet cement concrete mixtures, both for the purpose of waterproofing the concrete and reducing its tendency to spall. It has been found that there is little difficulty in incorporating petroleum residues with such mixtures, provided they are sufficiently fluid to handle cold, and some of the oils seem to produce no loss in the strength of the concrete in which they are used.

It is probable that in most concrete roads the concrete is too uniformly mixed and too homogenous in composition. In a measure this may account for the development of shrinkage cracks, where the surface is exposed to a great range of temperature. Concrete is also too unyielding to the blows of traffic and too brittle, both of which characteristics facilitate spalling. It would seem that a pavement might be made which to some extent would obviate these undesirable characteristics by so treating Portland Cement that its brittleness could be reduced and its resiliency increased. This, I believe, would be a great advantage, even though it should diminish the tensile strength. It is evident that a material like asphalt, which so successfully meets the wear of traffic, is of a semi-plastic nature with very low tensile strength and no elastic limit. Alone, a slight blow will make a permanent impression upon it. Its adhesiveness to mineral matters, however, permit its being tempered by a mineral aggregate to the desired consistency. It is also known that the addition of Portland Cement to asphalt surface mixtures is very desirable.

With these points in view, the Office of Public Roads has undertaken investigations to ascertain the practicability of mixing semi-asphaltic base oils with Portland Cement concrete with the object of obtaining the desirable properties of both the cement and asphalt. So far the results obtained have been very encouraging. Mixtures have been made of as high as 20 per cent. of oil, and both the 7 and 28-day tests for toughness and tensile strength showed a regular increase. Briquettes with a 5 per cent. additions of oil broke in tensions at 230 pounds after 7 days in soak, and 296 pounds after 28 days; with 10 per cent. oil, 228 pounds after 28 days; with 15 per cent., 246 pounds, and with 20 per cent., 203 pounds. The results obtained under impact were practically parallel with those under tension. Increased proportions of oil retarded both the initial and final set in increasing amounts; and the tensile strength and toughness were also reduced, but not in like proportions. It has been shown that concrete immersed or mixed with animal and vegetable oils disintegrates and, of course, this may be the case with petroleum.

This investigation, however, will be continued until the several points under consideration have been definitely settled. Should it be found that cement can be mixed with asphaltic base oils and greater toughness obtained, the value of cement as a road building material will be very much increased. These problems are all being worked out along scientific lines, and while we may not be able to solve them in their entirety, yet we may hope very soon to have worked out many phases of them in a thoroughly satisfactory manner, and be able to make a practical application of them to the road conditions in various sections of the country.

COLLEGE EXTENSION

BY JOHN PRICE JACKSON.

The last ten or twelve years have seen the rapid growth of a new feature in the educational work of the Land Grant State Colleges or Universities. The basis of this growth has been the principle enunciated by President Sparks, of State College, Pa., that an institution supported entirely by the taxes of the people in one form or another, should bring to the people the largest possible measure of educational helpfulness, or, in brief, that such institutions should take their facilities and possibilities to the people, and not merely wait for those who, by reason of age or environment, can come to them. The medium by which this is accomplished is termed "college extension." For many years there have been given, in many parts of the country, series of extension lectures on historical, literary, and other subjects related to the liberal arts, or pure sciences, but this new movement has to do particularly and directly with the practical problems of every day life.

There is an enormous field for usefulness in work of this kind among the great masses of the working people no matter what may be the particular industry in which they labor. Services can be given in a variety of ways to the farmer, to the mechanic, to the miller, to the printer, to the employee of mercantile establishments, and indeed to all people who work. The character of training which can thus be given is impossible in full through the ordinary, present established channels of education, however complete they may be, as they are not organized to deal with the individual with the flexibility that the various conditions of life make necessary.

This idea of making college educational facilities available to the whole people is not a new one, however, even though it has been little practiced in the past. Permit me to quote a moment from Dr. Louis E. Reber, who is Dean of the Extension Division at the University of Wisconsin, and who organized and is in charge of the largest state college extension movement in this country.

He says that, *"the principles underlying 'College Extension' as it is developing to-day were clearly foreshadowed as long ago as the early days of the Republic, when Washington said that 'in proportion as the institutions of government reflect public opinion, it is essential that that opinion be educated.' This being true, it follows that in a government of the people, by the people, widespread public education must be maintained by the State not only for the sake of the individual, but in the interest of the State itself.

"The privileges and duties of citizenship in a democratic country imply in the citizen an intelligent and comprehensive knowledge, not only of political policies, but also of questions of the most extensive scientific and economic application. It, therefore, becomes indispensable to the highest interests of the State that the best education attainable be placed within easy reach of every citizen. In the application of this principle, upon which every democracy is based, there is no logical limit.

"Thomas Jefferson spent much time and thought in elaborating the great conception of a school system in every State, graded step by step from the Primary Schools" * * * to the State Colleges, thence to a "National University." "It was not, however, until years later, in 1862, that a direct advance in this direction was made, when a bill was passed which provided for the establishment and maintenance of a system of State Colleges, designed to promote the welfare of the great masses of people in all sections of the country.

"Justin S. Morrill, himself one of the plain people, in sympathy with them in thoughts and feelings, and looking at things from their point of view, gave the largest meaning to the words of the Land Grant College Act" (of 1862, referred to in the preceding parapraph), "'*in order to promote the liberal ana practical education* of the *industrial classes* in the several pursuits and professions of life.'" It is upon this broad and practical platform that the several States joined with the National Government in establishing and maintaining the State Colleges, now often called Universities, as in the case of the University of Illinois, University of Wisconsin, etc. It will be further noted that, in the legislative act referred to, no one industry is designated, such as agriculture or mining, but the education is primarily to be for the "industrial classes" or the *workers,* whatever their duties in life. Is it not natural that these tax supported institutions should be called upon by the people to take up educational extension work for the benefit of the whole people?

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*Bulletin on University Extension, Published by the University of Wisconsin.

Dr. Reber further says (in regard to the College Land Grant Act), *"to educate, for the daily occupations of life, all people in all places*—this is the essential interpretation of the message, an interpretation upon which the aims and methods of extension throw a new light. Washington and Jefferson projected systems of popular education along the old classical lines. Lincoln approved the Morrill Act referred to, for service to the masses. Mr. Roosevelt advanced a step further when he said, 'for at least a generation we have been waking to the knowledge that there must be additional education beyond that provided in our Public Schools, Colleges, or Universities.'"

The Pennsylvania State College is the State institution established in the manner indicated above, by mutual action of the State Legislature and Congress. Possibly some of the work carried on by this institution, and with which the writer is more or less familiar, may prove a suitable method as any of bringing out in some detail the character of the work which is included by the name "college extension."

Probably no more important service can be rendered in Pennsylvania at the present, in the nature of extension, than that which will aid in the education of the masses of the people on the subject of improved highways. Work of this character has been undertaken by the Extension Department of the College, and it has taken partly the form of a Good Roads Train, which is now making an itinerary throughout the Commonwealth. The College has the co-operation in this work, of the State Highway Department, and the United States Office of Roads, and the train is being run by the Pennsylvania Railroad Company. This is as it should be, that is, the State College should act in conjunction with the various State departments, for the two can be of mutual service. The National Government showed its appreciation of the value of such work, when the law establishing the United States Office of Roads was passed, by stating that the establishment of this bureau was for the purpose of enabling the United States to join with the various land grand State Colleges of the Union in promoting good highways.

The work of the train is being followed up by the same Department by sending out helpful good roads literature to the various townships and counties of the State, and by sending experts to give technical lectures upon the subject. Plans are under consultation for offering prizes to school children for essays upon good roads, and for placing in the school houses pictures indicative of the value of good roads. These methods could be adopted more or less successfully by the public schools themselves, and by means of other associations, but the work would then be largely dependent upon the individual enthusiasm and capacity of many people with the result that it would not, everywhere, be well done. What more efficient method can be devised than to have this important educational work under the supervision of the College Extension Department, backed by a large faculty of trained experts, and with the support of the State Highway Department?

Extension can be of great aid to the State in solving the great problems of industrial education now before it. In our cities and towns, both large and small, are large numbers of people who are compelled by the character of our civilization to work in specialized lines and under conditions such that the great mass of them have no opportunity for self-advancement, and for improving their efficiency and worth to their country and to themselves. The number of people called into the manufacturing industries will relatively increase as we perfect agricultural and manufacturing labor saving devices. It is therefore evident that the problem of furnishing opportunity for the broadening of this great mass of our people is a most serious one.

Germany has gone far ahead of us in this matter, and has more vocational, continuation, and other special schools for aiding those who must be at work to support themselves and their families, than has any other country. It has been largely by her efficient development of this special preparation for work which has enabled Germany to advance so rapidly and take so high a place in the industrial markets of the world. Much aid can be given to the State through Extension, in co-operation with the State Department of Education, in laying out ways and methods and in superintending education of this character. In Pennsylvania a large apprentice school has been established and is being carried on in the city of Altoona, under the direction of the college. The expense of the school is borne by the corporation which employs the apprentices. Two hundred and fifty young men are to be found in this school. Each of these young men attends the school for half of a day through the week, and during the remainder of the week is at work earning his wages. His pay is continued during the school hours. Any visitor to this school readily comprehends the enormous advantage it will be to the young men to have had three or four years of such educational opportunity. Not only will they be far better citizens for the Commonwealth, but they will also be more expert workmen capable of performing greater service with less effort. Without such a school they would have almost no opportunity for this additional practical mental training.

Also in the city of Williamsport are to be found some ninety-four men ranging in age from eighteen years to well towards old age, who have entered a vocational class, the expense for which is paid by the Board of Education of the city, but which is under the supervision of the Extension Department. By aiding in the organization, laying out courses, and advising with reference to such vocational schools, the College Extension Department is able to aid materially in the rapidity with which we solve this vital educational problem referred to above which is now facing this nation, and which must be solved before the country can advance in the prosperity that our natural resources warrant.

Extension lends itself particularly to work among the industrial classes of people through combined correspondence and personal teaching. The work which has been done in Pennsylvania so far in both agriculture and the mechanical industries has been of the character of ordinary correspondence work, but it is properly supplemented by gathering together periodically those pursuing the courses, and giving them the personal help which is found to be necessary for properly carrying on educational training of this character. It has been found by long experience that correspondence work without this personal touch is, in many cases, apt to either fail or lose a large part of its value. Thus, if a student misunderstands a statement or principle the mistake is apt to follow him throughout his whole course of study, and unless corrected it may do his work irreparable damage. It is impossible to discover all errors of this character, except by personal conference between the teacher and student. There are several thousands of active students actively pursuing work of this character in Pennsylvania. The great bulk of them are at present studying agriculture; however, other industrial lines are developing rapidly.

It is well known in this country that, particularly in mining, accidents and accidental deaths are far more common than in European countries. This is largely a matter of ignorance and lack of care on the part of foremen and workmen. Accidents in mines can without additional expense, or trivial additional expense, to the operators, be avoided if proper training is given to the men employed. College Extension is particularly fitted to aid in improving conditions of this kind. That which has already been done in this State shows the valuable results which it is possible to accomplish. For carrying on this work the co-operation of the Y. M. C. A. was enlisted by Dean Crane, of the College School of Mines, and this organization has done noble work. By the combined efforts of the Extension Department with the Y. M. C. A., many institutes have been held at the mines, thousands of pamphlets have been distributed, and many classes have heard illustrated lectures upon proper precautions to be taken. Not only is the subject of accidents in the mines taken up in this way, but there are many other problems relating to efficiency, and avoidance of waste being presented, which should benefit tens of thousands of miners personally and the industry as a whole. Such work has, of course, the support and co-operation of the State Department of Mines.

In agriculture much activity is to be found in many parts of the country. In this State, under the direction of Professor Alva Agee, Director of Extesion, and his assistant, Professor M. S. McDowell—men of exceptional experience—Farmers' Weeks are held in various towns, to which farmers gather and receive a week of good, practical training by the best experts to be obtained in the country, and especially by men drawn from the Faculty of the College. Aid is given to the State Department of Agriculture in carrying on its regular institute work. Representatives are sent out to the farming districts, who give information to the farmers as to proper methods, without cost other than traveling expenses. Agricultural instruction trains are run over the railroads of the State, having aboard experts in farming, dairying and horticulture. Much very valuable work has been done in this way by actual instruction, and by showing how more detailed information of the character needed may be obtained. Hundreds of thousands of practical and useful agricultural bulletins have been distributed. A large number of people running into the hundred thousands, in one way or another, have received agricultural, mining, industrial and other instruction during the past twelve months in Pennsylvania through this new medium of education. Without this flexible and desirable form of bringing education to the people by a force efficiently organized, this great mass of people would have been without the ability to obtain needed information, or at least such information would have been more difficult to arrive at.

Another item of value in College Extension is the distribution of information gained by the State Experiment Stations. The Agricultural Experiment Station in this State has been organized for many years, while the Engineering Experiment Station has been at work for two or three years. Many valuable subjects are under investigation in these Stations, and it is through the Extension Department that the information gained therein is distributed to the people.

In addition to the work touched upon, much service is rendered by sending out special lecturers to aid in improving local conditions or practices, such as, for instance, in the use of fuels, aiding in the great "rural uplift movement," etc., by showing exhibits of an educational nature at public meetings, etc. The Wisconsin land grant institution, in addition to extensively carrying on such extension work as has been described, gives correspondence courses which are accepted for credit towards a college degree; aids women's clubs in their study and work; has a department of general information and welfare, from which much valuable information concerning municipal government and other matters related to the duties of citizenship is distributed; holds institutes for bakers; send about the State an educational "pure milk exhibit;" joins in anti-tuberculosis and other desirable crusades; organizes vocational schools in mercantile establishments; circulates useful industrial libraries; and so on.

College Extension has only been organized for three or four years in Wisconsin, but the results already obtained are so satisfactory that the people are now firmly behind it, as evidenced by the liberal appropriations given in its support. Pennsylvania is one of the leaders in this work, and it is having an active growth throughout the Union. It is destined to form a large factor in solving the great and vexing problems that have been arising during the last couple of decades, by reason of the changes wrought in our social organization and civilization through the use of inexpensive power and labor saving devices.

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REMEDY IN WATER WAYS

By F. Herbert Snow

Complying with petitions presented by numerous commercial organizations of the Mississippi Valley, President Roosevelt in the Spring of the year 1907, decided to appoint an Inland Waterways Commission, whose duty it would be to prepare and report a comprehensive plan for the improvement and control of the river systems of the United States. Eight public men were asked to serve on the Commission, and Representative Burton, of Ohio, chairman of the Rivers and Harbors Committee in the last Congress, was selected as chairman.

In a letter which he addressed to each of these persons, the President set out the reasons actuating him in the matter, namely, that he was influenced in creating the Commission by the broad considerations of national policy; that the railroads are no longer able to move crops and manufactures rapidly enough to secure the prompt transaction of the business of the nation, and that there appears to be but one complete remedy—the development of a complementary system of transportation by water.

The President's letter in full is as follows:

"The White House,

"Washington, *March 14, 1907.*

My Dear Sir: Numerous commercial organizations of the Mississippi Valley have presented petitions asking that I appoint a Commission to prepare and report a comprehensive plan for the improvement and control of the river systems of the United States. I have decided to comply with these requests by appointing an Inland Waterway Commission, and I have asked the following gentlemen to act upon it. I will be much gratified if you will consent to serve:

"Hon. Theodore E. Burton, chairman; Senator Francis G. Newlands, Senator William Warner, Hon. John H. Bankhead, Gen. Alexander MacKenzie, Dr. W. J. McGee, Mr. F. H. Newell, Mr. Gifford Pinchot, Hon. Herbert Knox Smith.

"In creating this Commission I am influenced by broad considerations of national policy. The control of our navigable waterways lies with the Federal Government and carries with it corresponding responsibilities and obligations. The energy of our people has hitherto been largely directed toward industrial development connected with field and forest and with coal and iron, and some of these sources of material and power are already largely depleted; while our inland waterways as a whole have thus far received scant attention. It is becoming clear that our streams should be considered and conserved as great natural resources. Works designed to control our waterways have thus far been usually undertaken for a single purpose, such as the improvement of navigation, the development of power, the irrigation of arid lands, the protection of lowlands from floods or to supply water for domestic and manufacturing purposes. While the rights of the people to these and similar uses of water must be respected, the time has come for merging local projects and uses of inland waters in a comprehensive plan designed for the benefit of the entire country. Such a plan should consider and include all the uses to which streams may be put, and should bring together and co-ordinate the points of view of all users of water. The task involved in the full and orderly development and control of the river system of the United States is a great one, yet it is certainly not too great for us to approach. The results which it seems to promise are even greater.

"It is common knowledge that the railroads of the United States are no longer able to move crops and manufactures rapidly enough to secure the prompt transaction of the business of the nation, and there is small prospect of immediate relief. Representative railroad men point out that the product of the northern interior States have doubled in ten years, while the railroad facilities have increased but one-eighth, and there is reason to doubt whether any development of the railroads possible in the near future will suffice to keep transportation abreast of production. There appears to be but one complete remedy—the development of a complementary system of transportation by water. The present congestion affects chiefly the people of the Mississippi Valley, and they demand relief. When congestion of which they complain is relieved the whole nation will share the good results.

"While rivers are natural resources of the first rank, they are also liable to become destructive agencies, endangering life and property; and some of our most notable engineering enterprises have grown out of efforts to control them. It was computed by Generals Humphreys and Abbott, half a century ago, that the Mississippi alone sweeps into its lower reaches and the Gulf 400,000,000 tons of floating sediment each year (about twice the amount of material to be excavated in opening the Panama Canal), besides an enormous but unmeasured amount of earth-salts and soil matter carried in solution. This vast load not only causes its channels to clog and flood the lowlands of the river, but renders the flow capricious and difficult of control. Furthermore, the greater part of the sediment and soil matter is composed of the most fertile material of the fields and pastures drained by the smaller and larger tributaries. Any plan for utilizing our inland waterways should consider floods and their control by forests and other means; the protection of bottom lands from injury by overflows, and uplands from loss of soil wash; the physics of sediment, charged waters and the physical or other ways of purifying them; the construction of dams and locks, not only to facilitate navigation but to control the character and movement of the waters; and should look to the full use and control of our running waters and the complete artificialization of our waterways for the benefit of our people as a whole.

"It is not possible properly to frame so large a plan as this for the control of our rivers without taking account of the orderly development of other natural resources. Therefore I ask that the Inland Waterways Commission shall consider the relations of the streams to the use of all the great permanent natural resources and their conservation for the making and maintenance of prosperous homes.

"Any plan for utilizing our inland waterways, to be feasible, should recognize the means for executing it already in existence, both in the Federal Departments of War, Interior, Agriculture and Commerce and Labor, and in the States and their subdivisions; and it must not involve unduly burdensome expenditures from the national treasury. The cost will necessarily be large in proportion to the magnitude of the benefits to be conferred, but it will be small in comparison with the $17,000,000,000 of capital now invested in steam railways in the United States—an amount that would have seemed enormous and incredible half a century ago. Yet the investment has been a constant source of profit to the people, and without it our industrial progress would have been impossible.

"The questions which will come before the Inland Waterways Commission must necessarily relate to every part of the United States and affect every interest within its borders. Its plans should be considered in the light of the widest knowledge of the country and its people, and from the most diverse points of view. Accordingly, when its work is sufficiently advanced I shall add to the Commission certain consulting members, with whom I shall ask that its recommendations shall be fully discussed before they are submitted to me. The reports of the Commission should include both a general statement of the problem and recommendations as to the manner and means of attacking it.

"Sincerely yours,
"THEODORE ROOSEVELT."

In support of this position relative to the transportation problem, James J. Hill, the great builder of the Northwest, the president of the Great Northern Railway, just one month later than the date of the appointment of the Inland Waterways Commission, gave out a complete summary of the situation showing it to be an absolute necessity for the well-being of the entire United States that recourse be immediately had to canals and waterways, as the most practical and economical means to handle the enormous freight tonnage to be moved in all parts of the country. He said:

The Railway Problem.

"The railroad problem is stupendous. The railroads cannot begin to handle the business. There is no prospect of building new roads, for the cost is prohibitive. It would cost a railroad $150,000,000 to get from Harlem to Forty-second street, in New York. One hundred and fifty million dollars would be at the rate of $150,000 a mile from New York to Chicago for a terminal in New York alone, to say nothing of other terminals and the additional cost of construction.

"Now, no practical man would accept a contract for furnishing the facilities required, including additional equipment and terminal facilities, for less than $75,000 a mile. The terminals now in use by the railroads, you must remember, were acquired years ago, when property was comparatively cheap. They can now be enlarged and added to only by heavy outlay. But in many cities additional facilities do not mean simply a matter of cost, for the necessary area cannot be obtained at any price.

"It does not exist within the area where the business must be handled and cannot be obtained unless the very business that it is desirable to handle is destroyed to make room for the terminals.

"Five billion, five hundred million dollars should be expended on the construction of railroads in this country. There should be a yearly expenditure of $1,000,000,000 for five years. That sum must be spent before the commerce of the country can be properly moved. Hardly anyone realizes what that amount of money means. It is twice the amount of the bonded debt of the United States after the close of the Civil War, and it is more than twice the amount of the entire currency in circulation in the country, and only a little less than twice the deposits in all the savings banks in the United States put together.

"Unless this money be raised, the business of the country will be prostrated. The business of the country is now so badly congested that from every quarter there are cries for relief. Everywhere there are freight blockades of enormous proportions, especially at the terminal points. And the situation is daily, hourly, becoming worse. It is the greatest business problem that has ever faced the nation.

"The first step in its solution is to properly understand existing conditions. These figures, compiled from the official returns of the Interstate Commerce Commission, cover the growth of the railroad business for the last ten years.

	1895.	*1905.*	*Increase, Per Cent.*
Total single-track mileage, ...	180,657	218,101	21
Locomotives, ...	35,699	48,357	35
Passenger cars, ...	33,112	40,713	23
Freight cars, ...	1,196,119	1,731,409	45
Passenger mileage, ..	12,188,446,271	23,800,149,436	95
Freight ton mileage, .	85,227,515,891	186,463,109,510	119

"These figures offer an explanation of the cause of the delay of the traffic movement of the country that threatens to bring our national industries to a standstill.

"Within the last ten years the volume of railroad business in this country has increased more than 110 per cent., and the railroads during this time have endeavored to meet it, for the increase in locomotives has been 35 per cent. and in freight cars of all classes 45 per cent., and there has been a substitution of larger cars for smaller, better methods of loading, and an increase in the weight of locomotives. All these things have added greatly to the carrying capacity of the railroads so far as rolling stock is concerned.

"Moreover, equipment is being increased as rapidly as capital and labor can increase it. The car and locomotive works of the country have all the orders they can fill for a year ahead, and there is no question that there will be cars and locomotives enough to carry the traffic of the country if the cars could be moved.

"A striking part of the situation is that railroad building within a generation has fallen off just as the demand for trackage has increased. The following figures show that when demand is greatest and the whole country is clamoring for relief, the percentage of increase in mileage to-day is the smallest that it has been in years.

	Total Mileage.	*Increase.*	*Increase, Per Cent.*	*Increase, Per Cent. Per Annum.*
1870, ...	52,898			
1880, ...	93,671	40,773	77.00	7.70
1890, ...	163,597	69,926	74.60	7.46
1904, ...	213,904	50,307	30.75	2.19
1906 (est.), ...	220,000	6,250	2.90	1.45

"The conclusion is easily arrived at—a common carrier has reached its limit when it is moving at all times over its system as many cars as can be run upon its tracks with safety, and transferred and dispatched from its terminals and junction points without unreasonable delay.

"Beyond a certain limit, then, increase of business cannot be handled by increasing cars and engines. The disparity between growth of traffic and the additions to railroad mileage, and the extension of terminals, shown by new mileage of less than 1½ per cent. a year for ten years past, presents and explains the real problem.

"The best judgment of many conservative railroad men in the country is that an immediate addition of not less than 5 per cent. per annum to the railroad trackage of the country for, say five years, should be made to relieve the situation and put an end to unreasonable delays in the transaction of business.

"No additions to equipment and no increased efficiency in operation of railroads can take the place of the imperatively required new trackage and terminal facilities.

"The country must have additional tracks and the country must have additional terminal facilities. Now suppose that only 25 per cent. additional tracks with the necessary terminals and equipments are built in the next five years, and without these additions the country cannot escape extreme distress and business depressions and cannot properly conduct the volumes of business now in sight, let us see how we shall come out, working on this basis. The total railroad mileage in the United States is about 220,000 miles. A 25 per cent. increase, then, would mean the building of 55,000 miles of new track, much of which would be additional tracks to existing lines, and if five years were allowed to the work, it would be necessary to build 11,000 miles of railroad each year. But that would not be all, for one-third more would have to be added to this amount of tracks for terminal and passing tracks, making, say, at the end of five years a total, in round numbers, of 75,000 miles of track. Most of this additional track would be built where traffic is the heaviest, for double-tracking existing lines, and it, therefore, would be expensive work. Grades would have to be lowered, curvature reduced, highway and other bridges built and expensive terminals created. You can see, then, that the estimate of $5,500,000,000 for the proper railroad accommodations of this country in the next five years is not much out of the way and in fact it is probably an underestimate of the situation.

"Looking at increased trackage from another viewpoint, the average speed of a freight train is from 12 to 15 miles an hour, and the average distance traveled by each freight car is about 25 miles a day. Therefore, the entire freight equipment of the country is employed to the fair limit of its capacity but two hours out of the twenty-four. On single-track lines freight must wait on sidings while passenger trains have the right of way, and freight cars stand for days and sometimes weeks in yards, or at transfer points, awaiting their turn.

"Our population is increasing at the rate of more than 2,000,000 a year, and it will not be long before the increase will be 2,500,000. Nearly all the products used by the people are carried by the railroads a longer or shorter distance. The value of farm products doubled in thirty years after 1870, and now it is estimated that their value is almost twice as great as it was five years ago. In ten years the output of petroleum has been more than doubled. In ten years the output of pig iron has increased

150 per cent. The value of manufactured products of the country rose from 9,372,437,283 in 1890 to $13,039,279,566 in 1900, and to grasp the situation in all its details you must realize that every addition to our imports and our exports means just so much more work for the carrier systems of the country.

"Looking at the industrial part of it—at the rate of 140 tons to the mile, it would require 2,000,000 tons of steel rails every year to furnish the 15,000 miles of track required. This is nearly two-thirds of the product of all the rolling mills in the United States. It would require the labor of 200,000 men in grading, besides track layers, bridge builders and others to complete the work of building this number of miles of road. The labor of such an undertaking cannot be obtained at any price. Laborers cannot now be obtained in sufficient numbers to provide for the ordinary extensions and improvements making at present. This, then, is the great business problem that confronts the United States.

"A decentralization of traffic must meet the prohibitory expense attached to the enlargement of terminals at many points and the lack of available space which cannot be obtained at any price. There must be more points for export—more interior markets. The heavy transfers of freight must be kept away from th great cities. And this decentralization of traffic would be brought about by canals.

"A fifteen-foot canal should be constructed from St. Louis to New Orleans, along the Mississippi. Such a canal would go further to relieve the Middle West and Southwest than any other work that could be undertaken. On such a canal a single powerful towboat would carry from 30 to 40 trainloads of freight. The transportation of freight by rail costs one-half cent a ton a mile. It could be carried on the canal on steel barges with a powerful towboat at the rate of one mill a ton a mile.

"The canal is the solution of the transportation problems. Railroad building has declined. That is certain. Business is blockaded. That is certain. Some means must be adopted for moving the business. The decline in railroad building is not an accident. The investors simply refuse to put their money into railroad enterprises which are now under the ban of unpopularity, and under the threat by individuals and political parties with confiscation or transfer to the State."

New York's $101,000,000 Erie Canal.

In the struggle for commercial supremacy 100 years ago, the importance of connecting New York city with the Great Lakes by waterway was grasped by the people and the result was the Erie Canal. Within the last ten years it has come about that the Mississippi River and its tributaries have made New Orleans the grain seaport of the continent. To retain its export trade the State of New York recently made an appropriation of $101,000,000 to be expended in changing over the Erie Canal to a 1,000-ton barge water-highway from the lakes to the sea.

On the other hand New Orleans and Chicago have clasped hands over a ship canal connecting Lake Michigan with the Mississippi River. The Chicago Sanitary and Ship Canal connects Lake Michigan at Chicago with the Illinois River at Lockport, a distance of 34 miles. The minimum depth of the canal is 22 feet, its width at bottom 160 feet, and the width at the top from 162 to 290 feet, according to the class of material through which it is cut. Its object was to give to the city of Chicago proper drainage facilities by reversing the movement of water, which formerly flowed into Lake Michigan through the Chicago River (an open sewer foul as a cesspool), and turning a current from Lake Michigan through the Chicago River to the Illinois River at Lockport, and thence down the Illinois River to the Mississippi. All bridges along the canal are movable structures. The total cost of construction was $34,000,000, of which 21 millions were for excavations, 3 millions for rights of way and 4 millions for railroad and highway bridges over the canal. The city and State authorities now propose that Congress shall make this canal a commercial highway by increasing the depth of the Illinois and Mississippi Rivers to 14 feet, with locks for fleets of barges from Lockport to St. Louis. This will give through water transportation from Lake Michigan to the Gulf and enable the United States in case of war to quickly transport light-draft war vessels from the Gulf to the Lake.

There are four profitable trunk line railway systems which parallel the Great Lakes from east to west; and yet the lake tonnage between Duluth at the western extremity of Lake Superior and intermediate points and Buffalo at the eastern extremity of Lake Erie, only 1,500 miles in extent, is five times as great as the combined coastwise tonnage of all the Atlantic and Gulf States, 4,000 miles in extent.

In 1898, Governor Black, of New York, in his annual message at the opening of the Legislature, called attention to the fact that the commerce of New York city was on the decline, while that of other tidewater ports was increasing. This message led to the appointment of the New York Commerce Commission, to examine into the commerce of New York city, the cause of its decline, and the means for its revival. The importance of the subject was likewise urged upon the Legislature by Theodore Roosevelt, then Governor of New York. Immediately upon his inauguration, in his first annual message in 1899, he said:

"Of recent years the city of New York has fallen off relatively to other cities as regards the increase of her commerce, and in exports there has been a positive decrease. Under my predecessor, a commission was appointed to examine into the cause of this decline. I recommend that this commission be allowed ample additional time to close its work, the subject being one of such vast importance, and that it be given needful aid."

The report of this commission found as follows:

"The decline in New York's commerce has been steady and continuous for many years; it has been more pronounced during recent years, and has now reached serious proportions in actual loss of exports.

"This loss has been largely in exports of grain and flour. While New York has been steadily losing, Montreal, Boston, Baltimore, Newport News and the Gulf ports of New Orleans and Galveston have made substantial gains.

"The State of New York has it within its power, through an adequate improvement of the Erie Canal, not only to apply the remedy that will secure it against further loss of its commerce, but that will secure to it as well the restoration of that which has already been diverted."

The present depth of the Erie Canal is but seven feet. Hence for foreign or coastwise traffic there must be through transshipments, viz: at the port of clearance, at Buffalo, and at New York city or Montreal. The ruling depth on the upper St. Lawrence is nine feet. This northern or Lake route is also closed for five months of the year. Yet the tonnage through the Sault Canal to Lake Superior alone, during the season of navigation, is now at least equal to that through the Suez Canal during the entire year. By this water route the territory of the Lake Basin is enabled to secure the benefit of competitive rates.

On November 3, 1903, the taxpayers of the State of New York, by a majority of over 245,000, voted in favor of the proposition to expend $101,000,000 in improving and enlarging the present Erie, Oswego and Champlain Canals. The existing canals are to be improved to 75 feet minimum bottom width and 12 feet minimum depth. It is estimated that 1,000-ton barges will carry coal and grain freight at a profit at a rate of fifty-two one-hundredths of a mill per ton-mile, or 26.1 cents per ton from Buffalo to New York city, rates which the railroads cannot compete against, and which will abolish the differential against New York of 20 cents to $1 per ton in favor of other ports.

The Erie Canal extends from the Hudson River at Albany to Lake Erie at Buffalo, a distance of 351 miles. It has 72 locks, the summit level, 572 feet above sea level, being at Buffalo. There is a flight of 16 locks between West Troy and Cohoes which surmount a difference of 121 feet in elevation in a distance of 4 miles. At Lockport, 28 miles from Buffalo, there are 5 locks which overcome a difference of 60 feet in elevation.

The consensus of opinion is that the enlargement of the Erie Canal so as to carry boats of from 1,000 to 1,500 tons burden will cause such a great influx of people into the State along its banks, and so many additional manufacturing enterprises that the business of the railroads in the carriage of passengers and high-class freight will be very much augmented and the railroads will profit accordingly, although the canal will carry the low-class freight at a much reduced rate.

Development of Waterways in Germany and France.

In Germany and France for many years there has been a very great development of waterways. All their rivers have been developed and improved and connecting canals have been constructed in many places. It is said that freight can be conveyed by water from practically ever part of France and Germany to every other part.

A study of the German waterways by those who have been willing to engage in laborious and extensive collection of statistics seems to have proven that Germany's industrial success is due chiefly to cheap transportation, and especially to the wise development of her waterways. The reader may not be willing to go so far in conclusion, but there is at least one prominent fact, namely, that recognizing the importance of cheap transport such as an alternative transport system, which would bring with it wholesome competition, Germany has steadily extended and enlarged and improved her natural and artificial waterways, and keeps on extending and improving them year by year.

Everywhere one may witness this vigorous and energetic developement. In all the rivers and all the canals commercial and industrial activity is marvelously developing, and the inland waterways is now almost a passion with the German business community. Is it possible that these people have fooled themselves into believing that waterways help industries to flourish? When ice closes the German rivers and canals, the export and import trades are at once very seriously affected. Block the German waterways for a whole year and the whole of Germany would be ruined. One writer has said:

"Certain valuable products and by-products of the German mines and iron-works, and the more bulky product of the chemical industries of Germany can, according to many, only be sold in Germany and abroad, owing to the cheapness of transport by water, and in many cases the profit is cut so fine that an increase of the freight charges by about one-fifth of a penny per ton per mile would inevitably kill important industries which, it seems, are at present killing the industries of countries competing with Germany. Thus Germany's industrial success is no doubt due to a very large extent to the immense assistance which she receives from her waterways.

The Merchants' and Manufacturers' Association of Pittsburg, Pa., is advocating the necessity for a canal to connect Pittsburg and Lake Erie, gave a brief summary of the development of canals abroad:

"France began building canals as early as the Christian era, until now she has over 3,200 miles of canals, and with improved rivers over 7,000 miles of canal and river transportation in operation, and the points in France showing the greatest growth in population and commercial activity, and where the railroads do the largest and most profitable business, are located on these waterways.

"In France it has become a settled conviction, accepted by the railroads themselves, that water communication is a necessity to the economical operation of the railway, and the canals create the conditions making it possible for manufacturing industries to thrive and prosper, and population and wealth increase; and the railways share in the increased prosperity through the carriage of passengers and increased commerce in manufactured products, and the distribution of the same to the consumer.

"In the past twenty-five years Germany has expended large sums in connecting the interior rivers with each other, and the ocean by canals, affording the cheapest transportation for the raw materials entering into her manufactured products and the result has been a vast and rapid increase in the population and commerce of her cities, and the increase of business on the railroads that were supposed to be affected showed a greater percentage of increase than on the waterways themselves

"Is it not a significant fact that immediately following this activity of Germany in improving her waterway service, she passed England in manufacturing supremacy?

"Liverpool established her commercial position in the world by expending $106,000,000 on improvements at the mouth of the Mersey River.

"Glasgow caused the ebbing tide of commerce to flow backward into her midst by spending $60,000,000 in digging her way out to sea by way of the Clyde."

Manchester Ship Canal.

The city of Manchester, England, furnishes a striking modern instance of the value of an artificial waterway in developing an inland city.

Most great cities owe their importance either to geographical situation or to the growth of special trades, to which, in many instances, the material surroundings and conditions contribute; or to special circumstances resulting from human ingenuity or science.

Manchester long held a predominant position as the home of cotton manufactures, and the center of commerce created by them. Its commercial supremacy and the special advantage which it had hitherto enjoyed, began to be impaired. However, at the commencement of the last quarter of the last century, the competition to which the district was subject had become so severe, that the cost of transit had become the determining factor in many of the heavier industries. From this and other kindred reasons, the agitation for the construction of a ship canal started.

At the time the canal was projected (1882), the city had entered upon a period not merely of arrested development, but of actual depression. Her industries were languishing, some of them leaving her, and many of her business establishments becoming tenantless, because of the greater advantage of Liverpool and other points in the United Kingdom located on deep water.

Manchester in her great effort had in view not so much the reduced distance, as rates—to bring the ocean in competition with railroads. Persisting in the face of many defeats and hindrances, both in Parliament and out, and against the united, bitter and well-organized opposition of the railroad interests centering in the city, and the Mersey Docks and Harbor Board Corporation of Liverpool, and overcoming physical difficulties almost unparalleled in the history of great engineering undertakings, January 1, 1899, saw the canal open and doing business.

The canal cost $75,000,000, of which sum the city bonded itself to the extent of $50,000,000.

The interest in the canal project was very strong, must have been to produce the result. The cities and towns along the line of the canal bought blocks of shares with municipal funds; the mills and manufacturing corporations bought them in large blocks; the individual men in the district within 20 miles of the termini, believing in the prosperity the canal would bring, bought as much as they could.

Parliament paid or allowed a 5 per cent. interest to be paid on the shares from the first, because it seemed as though a great many years might pass before dividends could be paid out of the profits. Contrary to expectations, genuine dividends were paid quite early.

There was a hard fight to get the right to dig the canal. Two lines of railroad paralleled the route, and they fought it with all their might in Parliament and out of Parliament. Finally they were beaten, and the result has been that instead of having to go out of business, both railroad lines are doing better to-day than ever before, on account of the growth of the district. Mr. W. Henry Hunter, chief engineer of the Manchester Ship Canal, at the International Engineering Congress, St. Louis, Mo., October, 1904, said:

"The operation of the Manchester Ship Canal has directly or indirectly affected beneficially the whole of the greatest industrial district on the face of the earth; a district of which the present population does not fall short of 10,000,000 persons, while in the more limited area, of which the city of Manchester is the heart and center, many industries have been saved from extinction and many others from decline and ultimate decay. As surely as in the days of our forefathers, nations struggled between themselves for tribute from others, now they struggle for trade with others, and the issues are vital it is verily a struggle for existence. In such a struggle the best-equipped community must have the advantage, and must succeed and survive, while the community which stands still where others are pressing forward, must fall back, must fail, and commercially perish.

"Experience has shown that cheap and ready transport is an essential factor for the success of any trading community, and that transport of such a character can only be assured where waterways deliver the trade from the iron grip of monoply. The statement, therefore, that waterways must form part of the equipment of any progressive nation which would hold its own in the struggle with its contemporaries becomes simply the third term in a syllogism.

The following is a comparison of the traffic for the first 14 years during which the ship canal has been open:

Seaborne Traffic.

Year.	*Tons.*
1894,	686,158
1895,	1,037,443
1896,	1,509,658
1897,	1,700,479
1898,	2,218,005
1899,	2,429,168
1900,	2,734,843
1901,	2,684,833
1902,	3,137,343
1903,	3,554,636
1904,	3,618,004
1905,	3,993,110
1906,	4,441,241
1907,	5,210,759

The revenue for 1907 was £535,585.

The principal docks are equipped with modern terminal freight handling devices. There are transit sheds, steam, hydraulic and electric cranes, and other appliances for giving quick despatch. The ship company's railways, over 100 miles in all, convey traffic between the various loading and discharging berths at the docks and along the canal, and are connected with all the railway systems entering the city at the limit of the yard. The company originally secured large tracts of land adjoining the canal, and it has for sale or lease, under proper restrictions, plots of land suitable for the erection of works of all kinds, with frontage on the canal and connections with the principal railways.

Development of the Carrying Trade on the Great Lakes.

It is not too much to say that the development of the carrying trade on the Great Lakes, both in the number and kind of vessels used, is due almost wholly to the "Soo" Canal.

There had been a canal around the Falls in St. Mary's River, between Lake Superior and Lake Michigan, available for vessels drawing not over 10 feet of water, from 1856 on; but there can hardly be said to have been a ship canal until 1881, when the United States Government completed a 17-foot channel between the lakes, and provided a 515-foot lock, with a single lift of 18 feet, for carrying vessels from the level of the lake to that of the other. The growth of the traffic through this canal led the Dominion Government to construct a canal around the Canadian side of the Falls in 1895, and in 1896 the United States' canal was enlarged to a 20-foot channel and provided with an 800-foot lock.

From special U. S. reports is quoted the following:

"The volume of traffic through this canal far exceeds that through the Suez Canal. In 1881, the traffic of the old St. Mary's Falls Canal was 1,560,000 tons, as against 4,130,000 tons through the Suez Canal; but with the enlargement of the American canal a rapid increase in traffic immediately developed. In 1889 it equaled that of the Suez Canal (about 7,000,000 tons in each): in 1895 a tonnage of 15,000,000 tons went through the St. Mary's Falls Canal, as compared with 8,500,000 tons through the Suez Canal.

In 1900 the traffic had been increased to 25,643,073 tons, and in 1906 the volume rose to the enormous amount of 51,751,080 tons.

Iron and steel are the largest items in the traffic. The development of the Lake Superior region has transferred the pig iron and steel manufacture from the East to the West of the Alleghenies. The Superior ores deposits have made profitable the use of labor-saving machinery in mining, and the construction of special terminals for loading and unloading ore.

"An interesting case of interacting causes is to be seen in the relation between the Lake Superior iron mines and the shipping on the Great Lakes. It was the development of the iron mines which furnished the trade of the large steel steamships and also the material for constructing them, while the use of the barges and ships has lowered freight rates and still further developed the iron industry. The development of the Lake Superior iron mines has been an important factor in causing the great reduction in the price of Bessemer steel, and it is this reduction that has made possible the largely increased use of steel in shipbuilding, in bridges, in heavier rails, and in the tall buildings of our large cities. Indirectly, then, all these improvements have depended to a large degree on the existenc of th St. Mary's Falls Canal."

"From 1855 to 1881 the canal was controlled by the State of Michigan, and tolls were charged to cover operating and repair expenses, the rate at first being 6½ cents per registered ton, which was gradually reduced to 2½ cents. Similarly, the minimum charge for lockage for a boat was reduced from five to three dollars. Since control was transferred to the United States in 1881, the canal has been free for the public use by all nations."

Canal Projects.

The Georgian Bay Canal Commission recently completed at a cost of some $600,000 a through survey of the proposed 21-foot waterway from Georgian Bay to Montreal via the French River, Lake Nipissing, and the Ottawa River. The report of the Commission, placed before the country at large, reliable information as to the cost and feasibility of this great project which has now been before the public for half a century. The minimum cost will be $105,000,000. The great question is whether the benefits which will accrue to the Dominion through the construction of a waterway making Fort William practically an ocean port and shortening the present distance by water from Fort William to Montreal by more than 400 miles, will justify an expenditure larger by $15,000,000 than has been spent altogether on the Great Lakes and St. Lawrence waterways system.

The Lake Erie and Ohio River Ship Canal project is temporarily slumbering but its promoters are actively at work and will be heard from quite soon.

Back in 1889 the Legislature of Pennsylvania appointed a commission to inquire into the practicability of a ship canal between Lake Erie and the Ohio river, and appropriated $10,000 for its use. This commission, representing a State movement, sought for a canal within the State of Pennsylvania. It reported that a canal could be built via the Beaver and Shenango rivers to Conneaut Harbor at a cost of about $30,000,000.

In 1893 a provisional committee of thirty-five members was organized in Pittsburg to inquire into the matter of a canal to Lake Erie. This committee being composed of representative business men from Western Pennsylvania, Eastern Ohio and West Virginia, raised a fund of about $40,000 and put three corps of engineers in the field, and made a most exhaustive inquiry into the matter, covering over three years in its investigations, and issued its report in 1897.

It found it entirely feasible to build a canal via the Beaver and Mahoning rivers to Niles, Ohio; thence in almost a straight line across the lowest divide between the Ohio and Lake Erie to Ashtabula Harbor, the actual canal construction being only 52.64 miles from Niles to Ashtabula, including 31.35 miles to Summit level without a lock; the remainder from the headquarters of the Ohio to Niles being mainly providing slackwater navigation in the natural water courses, and in some instances straightening the bed of the Mahoning river in the bottom lands where extreme curvature exists.

The total length from Davis Island Dam, to Ashtabula is 122.16 miles. The dimensions of the canal recommended were 15 feet depth, bottom width 107 feet, surface 160 feet, locks 340 feet long and 45 feet wide and 184 feet less lockage and 92 feet less elevation, than the route surveyed by the Pennsylvania Canal Commission to Conneaut Harbor. The total number of locks proposed 33, as compared with 133 locks on the old Beaver and Erie Canal via Conneaut Lake. The summit level proposed is 327 feet above the mean level of Lake Erie, and 197 feet above the Ohio river at Pittsburg. The descent from Lake Erie to Lake Ontario through the Welland Canal is 327 feet also. The latter has 25 locks. The proposed canal 17 only from summit to lake.

The committee found that a specially constructed type of vessel adapted to both lake and canal navigation, could profitably handle this traffic without transfer of cargo at Lake Erie, at not exceeding one mill per ton per mile for freight charge through the canal.

A 15-foot ship canal between Pittsburg and Lake Erie would have a capacity for tonnage movement so it is stated, equal to 15 double-track railways, and could perform the service at about one-sixth to one-eighth the rate at which the railroads can do it. The whaleback steamer with two barges in tow, which could come through the canal carrying 7,000 tons, is equal to 140 cars with an average load of 50 tons, or four trains of 35 cars each.

For more than two hundred years the desirability of some sort of a waterway across Cape Cod, has been freely discussed, and numerous acts have been passed designed to accomplish that result. In all these projects the primary consideration has been the humane effort to obviate the danger to life and property incident to navigation in its treacherous waters. Because of its fogs, narrow channels, adverse currents, shifting sands and contrary winds, it is more dreaded by mariners than Hatteras or the Banks of Newfoundland. Its average annual record of the loss of thirty lives and property valued at $500,000 is reason sufficient for the construction of a canal if no other object was apparent.

Another reason for these efforts exists in the charges which this dangerous barrier imposes on New Englands commerce—the high rate of insurance, cost of labor, maintenance, interest on plant, equal to at least 40 cents on every ton (30,000,000 tons per annum) passing North and South around the Cape. The saving in distance and thereby in time has also been taken into consideration in these efforts for relief. But these reasons while sufficient for the Federal Government or the Commonwealth to act upon have been hardly sufficient to interest private capital, until recently.

The distance from Point Judith to Boston by the usual inside route is 170 miles, while a canal across the Cape would reduce the distance to 110 miles, and it may be observed in passing that the distance by the canal proposed by the act incorporating the New York, Brockton and Boston Canal and Transportation Company fixes a route reducing the distance to 75 miles.

The idea of a canal connecting the waters of Narragansett and Massachusetts Bays was originally a government project, and a part of a comprehensive "inside route" between Albermarle Sound and Boston Harbor.

In 1825 President Monroe sent to Congress a special message, transmitting a report from the Secretary of War, with a report to him of the chief engineer, of the examination which had been made by the Board of Engineers for internal improvement in accordance with previous instructions.

In this report was a consideration among others, of a waterway "between Buzzards and Barnstable Bays and the Narragansett roads and Boston Harbor," with explanatory observations at length on each.

The President, in commenting on the report, said "From the view which I have taken of these reports, I contemplate results of incalculable advantage to our Union, because I see in them the most satisfactory proof that certain impediments which had a tendency to embarrass the intercourse between some of its most important sections may be removed without serious difficulty, and the facilities may be afforded in other quarters which will have the happiest effect."

This particular route was advocated as a war measure. The system of defence proposed, contemplating not only fortifications to secure the chief harbors against capture or control, but also a plan for inland navigation on which in time of war, reliance might be placed as a substitute for external navigation. This was not a vital conclusive reason.

Beginning at Boston Harbor, this inland route, out of reach of an enemy's guns, would extend to Narragansett Bay, through the salt-water lagoons and shoals in the rear of Point Judith, through Long Island Sound to New York Harbor, through the Raritan river, the Delaware and Raritan Canal, through the Delaware river and the Delaware and Chesapeake Canal to the Chesapeake Bay, throught this bay, Hampton Roads, and the Elizabeth river to the Dismal Swamp Canal, and thence through the Albemarle and Chesapeake Canal to the Albemarle Sound.

During and since the late war with Spain, the National authorities have given more active study to the permanent defence of our coast line. In time of war it may be necessary to close the harbors and several inlets from the sea, which intersect the lines of internal communication, and to protect our great naval establishments. The system of defence devised not only comprehends fortifications to secure the chief harbors, but also provides for inland navigation, by canals, slack-water, in which in time of war reliance must be placed as the substitute for exterior navigation. The above route is unchanged. From Albemarle Sound the route is through the swamps, land-locks, sounds and lagoons of the Carolinas and Georgia to Florida; thence to the Gulf of Mexico, and thence through interior sounds and bays to New Orleans.

The impediments to this extensive line of internal navigation were never many; most of them have already disappeared before the energy of the local or state enterprise, and surveys have been made by the national government, and work already begun under annual appropriations to remove the remaining ones.

Already gun-boats can pass fróm Narragansett Bay to a point 100 miles South of Cape Hatteras without once passing outside the land-locked system described above, and by a few short cuts outside can continue on the same lines to the coast of Florida.

Any canal through Cape Cod—and one is now being built by a company—must have a terminus in Plymouth Bay, from which, or on the broad easterly end of which, or all along the Massachusetts coast from Plymouth Bay to Boston Harbor, a foreign fleet of vessels could control the situation; and the same exposure to a foreign fleet exists at Buzzard Bay. A canal across the cape would have been built long ago by the United States except that it did not meet the requirements of being inside of the front or exposed line of operations in the event of war.

The eastern portion of New England, of which Boston is the commercial centre, is hemmed in by the Berkshire Hills. The railroads from the west have a grade of over 900 feet to climb to reach the sea coast, and commerce will ever seek the channels of the least resistance, so the tidal river that flows by Albany will always divert the main part of the commerce to and from the west to New York City.

The circumnavigation of Cape Cod, almost as much of an obstacle to easy commercial conditions as the Berkshire Hills, is however a barrier that can be completely annihilated by a ship canal and this private enterprise now proposes to do.

The mammoth barges which carry the products of the West to the sea and the raw materials of the central and southern States by river and the great canal system of navigation, can be brought by this canal to the New England coast and to Boston without the danger and expense of collision, wreck, delay and uncertainty which the circumnavigation of Cape Cod necessarily engenders and when the modern ship canal to connect the Hudson river and the Great Lakes is completed, greater steam barges will be operated which will bring the freight of the Northern and Western States and Canada, without "breaking bulk" direct from the mines and fields, to be discharged on the wharves and into the warehouses of Boston.

Were it possible to rehabitate the early canals of Pennsylvania, improved, from the coal mines to tide water, it would be possible with the Rhode Island and Boston-Fall River Canals proposed, to supply all eastern New England with its coal direct from the mines to the consumer, without re-shipment at any point after loading at the mines.

How Canals Would Help Railroads

The history of transportation the world over, (generally speaking and not with respect to special instances) has established one fixed thing, that rail and water transportation, side by side, work no injury to the interests of each, but on the contrary, the greater the facilities for water transportation, in proportion are the railroads the greatest beneficiaries from the existence of this ideal and economic condition. All improvement in facilities for water transportation have resulted in the diversificaton and distribution of industry and added to the volumn of business done. They are not, and should not be, hostile rivals to supplant or drive each other out of business. They are rather to supplement each other, having distinct spheres of usefulness in the movement of commerce, and each helpful and beneficial to each other, working within their proper sphere. Said a well known president of one of the Western roads "In a general way my idea has been, and is, that the construction of the Isthmus Canal would be beneficial to the Mississippi Valley, as well as to the Pacific Coast. I incline to think cheaper transportation for heavy freights between the Mississippi Valley and the coast would so increase general business that the railroads would get back, out of high class freight and passengers, more than they would lose by the loss of low class traffic where time is not important."

It needs but a glance at the map to show that most of the great cities of the United States are located on waterways. The prosperous cities and towns on the Great Lakes from Duluth to Buffalo and along the Erie Canal grew up through the existence of these waterways, and all owe their success to the development of water traffic, competing with and fixing rates of land transportations. Paralleling these waterways are some of the best paying railroads in the country. The shore line along Long Island Sound, does not suffer by its proximity to that waterway. Flourishing cities and towns are found feeding and being fed by railways and waterways. The southern ports are growing because of the Panama Canal, and railroads are extending their lines south to participate in the increasing and anticipated traffic. New Orleans is pressing to the fore with rapid strides.

In these competing sections some of the traffic is diverted to the water that would otherwise move on the land, but the increased traffic on the water builds up new industries along the route, new communities spring into existence, old ones take on new life. The tributary country is developed and new points for distribution are created, and the railroads reap the harvest, and shipper and consumer share in reduced rates. The railroads do not feel the development of water lines to their injury, for they cannot ship the freight waiting on their platforms. But the country feels it and is immensely benefited by it.

These are some of the arguments to be pondered by those who scoff at the idea of the development of the Susquehanna river as a waterway. What would be more conducive to a Greater Harrisburg? Will not future generations witness this consummation? The subject is bound to be discussed more in the future than it has been in the past. There is not much danger of the project being undertaken right away. But if the general principles enunciated above are not applicable to Harrisburg and the Susquehanna basin, as elsewhere I would like to know for one wherein the difference is, and why waterway transportation would not prove of incalculable advantage to the industrial growth of this section of the country, and also contribute to and insure financial prosperity of the railroads operating here.

THE POSSIBILITIES OF IMPROVED NAVIGATION ON THE SUSQUEHANNA RIVER

By Farley Gannett,* Member.

It seems a well established fact that artificially improved river navigation is most likely to be commercially expedient where the waterway is the natural outlet of a large volume of bulk freight. Especially is this true where the freight can be laid directly on the boats at its origin and delivered to its consumers direct from the same boat, without transfer from railroads at its original point, or transfer to cars for final delivery, and furthermore without transfer from one boat to another. Thus the most favorable conditions for internal navigation would seem to be: 1, where all the freight hauled is of one kind, so that the boats can be designed for its most economic handling; 2, where the freight originates at points reached directly by the waterway; and 3, where the freight is consumed at points directly reached by the waterway. Still more favorable would be the condition of similar return freight, but this is seldom possible. Under these conditions a large volume of traffic should result, low rates prevail, and competing railroads be relieved of their least profitable and most embarrassing traffic.

Such conditions exist on some of the rivers of this country, and in certain cases measures have been taken to improve the navigation and take advantage thereof. The United States Government has recognized these conditions as existing along the Allegheny, Monongahela and Ohio rivers by improving navigation on these streams, and it would seem that they should be recognized as existing along the Susquehanna river, and the North Branch thereof. It is to the conditions existing along this waterway that I desire to draw attention.

This stream passes through the extensive Wyoming Valley anthracite coal field, the coal lands extending from Shickshinny on the south, through Nanticoke, Plymouth, Wilkes-Barre, to Pittston, and connecting with the Scranton field by the Lackawanna river. It is the presence of this vast coal field on its upper section and the connection by internal channels from its mouth with Philadelphia, Baltimore, Wilmington, Norfolk, Washington, etc., that makes the Susquehanna river exceptional in this respect.

The North Branch rises in the Catskill mountains of southern New York State, adjacent to the headwaters of the Delaware river at an elevation of approximately 2,000 feet above tide, flows in a generally southwesterly direction with many bends and wide sweeps, to its junction with the Shenango and Chemung rivers near the New York-Pennsylvania boundary near Binghamton, N. Y. and Sayre and Athens, Pa. Below this point the river has a considerable flatter slope, flowing southerly to the mouth of the Lackawanna, and thence southwesterly to its junction with the West Branch at Northumberland and Sunbury. Between the New York State line and Northumberland its slope is quite uniform, about 1.4 feet per mile, made up of riffles and stretches of comparatively slack water, with a few important rapids, such as that at Berwick, where the fall in 0.5 mile is approximately 7.5 feet. From the junction of the West and North Branches to Columbia, a distance of 81 miles, the slope is steeper but quite uniform at 2.4 feet per mile, broken by rapids where the river has cut through the transverse ridges of the North and South mountains. A few miles below Columbia the steepest portion of the river's profile in Pennsylvania begins, and from that point to the State line, about 13 miles above the mouth, a distance of 22.75 miles, the slope averages approximately 6.0 feet per mile, reaching a maximum grade of over 8 feet per mile.

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*Engineer, Water Supply Commission of Pennsylvania.

Below the mouth of the Lackawanna, the river is dotted with islands, those in the upper portion being mostly low and sandy and usually overflowed during floods. Farther down some of the islands rise considerably above flood stages and are inhabited and cultivated.

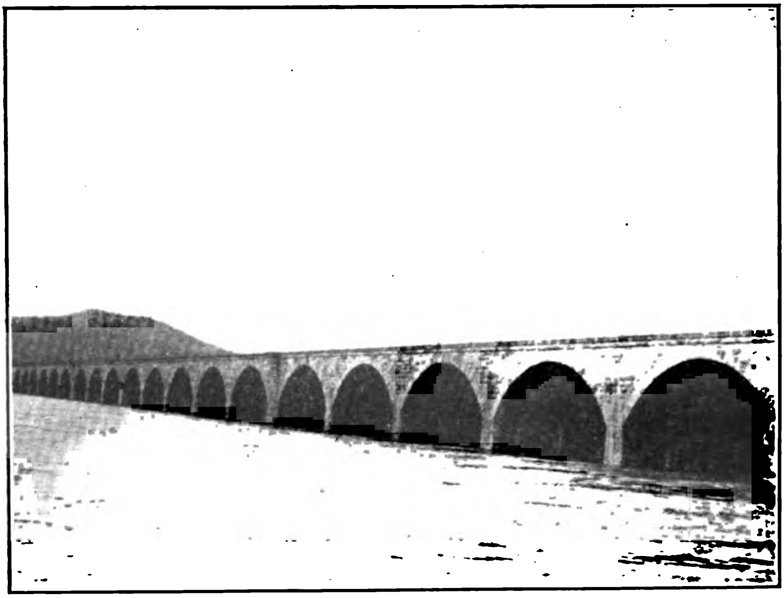
Between its mouth and the mouth of the Lackawanna, a distance of 182 miles, the section which will be hereafter considered, and the portion which would seem to offer the greatest inducements to improved navigation, the river is crossed by three dams, those at McCall's Ferry, Clark's Ferry and Nanticoke. The Columbia and Sunbury dams have within recent years been destroyed. The McCall's Ferry dam is a solid concrete structure 50 feet high, recently completed for water power development, and the company building it has agreed to install the necessary locks in case navigation is improved. The Clark's Ferry dam is about 8 feet high, erected in connection with the Pennsylvania Canal, a stone crib structure, now in disuse and disrepair, and the Nanticoke dam is quite similar.

Although the business conditions may be favorable for originating a large traffic in bulk freight, and the slope of the stream and possible water power developments are advantageous, on the other hand artificial changes have been made along the valley, which it would be difficult to overcome.

The many bridges would offer considerable obstacles to the improvement of the river, and heavy expense in placing draws therein. The stone arch bridges at Rockville and Shocks Mills would prove the greatest obstructions of this character.

The river has become greatly silted up through washings from its banks, and tributaries, and from coal mines and culm piles, and the condition of its banks and those of its tributaries should be improved and the washings from coal mines stopped, if navigation were improved. The refuse from the mines consists of: 1, "slate," (the rock which lies in contact with the coal) much of it good sized pebbles, which lodge higher up the river; 2, the finer "culm" which is this same material but

North Branch of Susquehanna River near mouth of Lackawanna River.



Railroad Bridge over Susquehanna River at Rockville, Pa.

much finer; 3, sand, and 4, fine coal. The three latter materials are deposited far down the river, and the coal being lightest, is carried as far as Harrisburg, and even beyond.

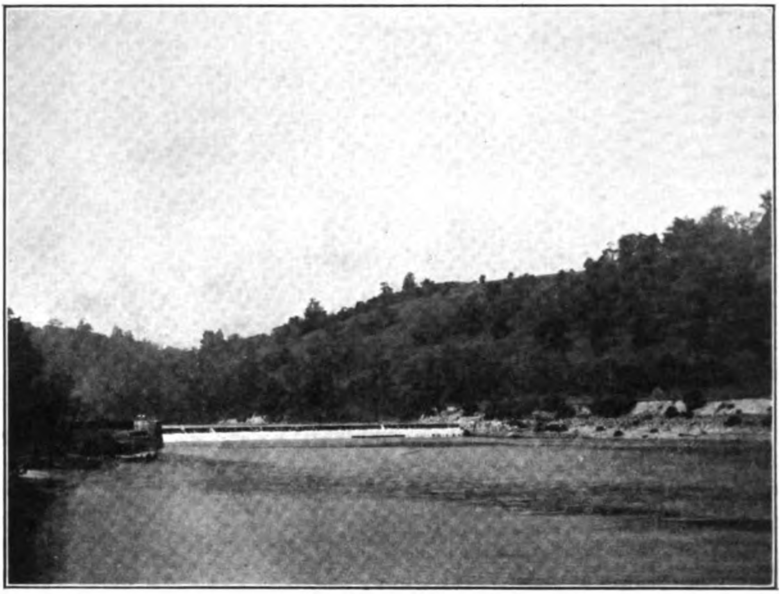
Both sides of the river from the source of the Lackawanna to its mouth are followed by railroads, most of the way, and the railroad embankments usually adjoin the water's edge. These banks are constantly sloughing off and adding their load of silt, and most of the tributaries are in the same condition. Industrial plants at nummerous points, as well as municipalities, dump solid waste materials, as well as sewage, into the stream, adding still more to its silt. It is during freshets that the bulk of material is picked up by the river and deposited below to form bars and islands.

The flow is exceedingly variable. The maximum discharge at Harrisburg is 520,000 second-feet, and minimum 2,330 second-feet, with an average discharge from 1890 to 1909 inclusive of 38,200 second-feet. At Danville, near the mouth of the North Branch, the maximum is 306,180 second-feet, minimum 830 second-feet, and average from 1899 to 1909 is 18,000 second-feet. During very high stages the velocity reaches 5 or 6 miles per hour. At low stages only occasional short stretches permit of navigating other than flat bottom boats of a draft of a foot or two. Even the scows used in sand and coal dredging and small flat bottom ferry boats have been forced to discontinue operations during exceptionally low stages. During the average winter the river is frozen for considerable periods.

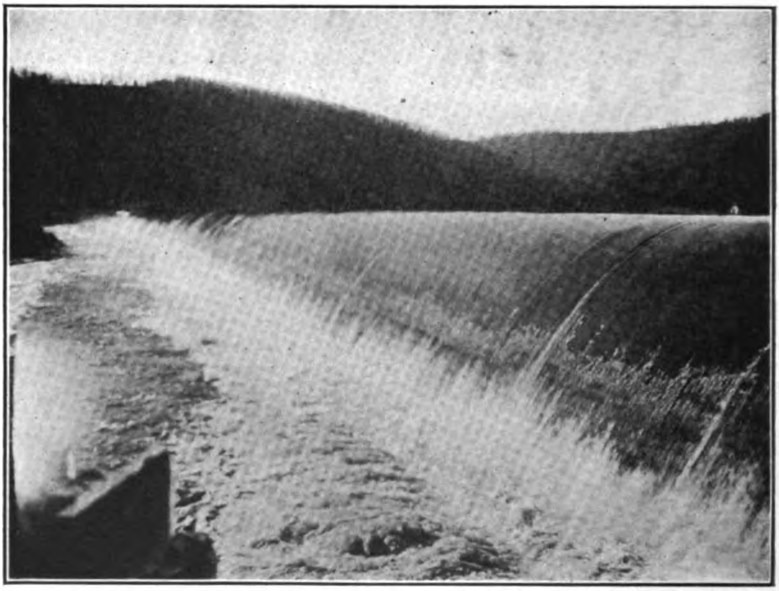
It is thus apparent that in its present state navigation must amount to little, and that to dredge a channel through its rocky bottom would be exceedingly expensive. Paralleled as it is by railroads on both shores, which occupy all of the available space between the river and steep mountain sides at many points, the construction of a canal would seem to be impracticable. Slack water navigation, therefore, appears the most feasible mode of improving navigation on this stream, its many and often long islands lending themselves to dykes and other channel regulation.

From its mouth the Federal Government has dredged a channel 15 feet deep up 5 miles to Havre de Grace, all of which is within the range of tidewater. From this point to the McCall's Ferry dam, a distance of 23 miles, the river rises 113 feet, of which a projected power dam at Conewingo would take up 50 feet, leaving 63 feet to be taken care of by other dams. Slack water above the McCall's Ferry dam now extends about 7 miles. From this point to Sunbury, the total fall of 225 feet in 93 miles would require numerous dams, at which power in large volume would be available. From Sunbury to the mouth of the Lackawanna, 72 miles, the dams would be much less frequent owing to the reduced slope, and less expensive owing to the decreased width of the stream.

In the days of the Pennsylvania canals, the line from Nanticoke to Columbia was financially successful as long as it had an outlet by way of the Union Canal and Susquehanna and Tidewater Canal and for years under the State management



Locks in Dam on Monongahela River.



McCall's Ferry Dam.

it was a large revenue producer. After the Pennsylvania Railroad purchased the canals, this line was deepened and widened and for many years helped materially to reduce the deficit incurred by the other lines. And the reason for this was that it hauled coal in large quantities direct from the mines to the consumers in the large cities along the seaboard.

The mines which would contribute to such a navigation line today are those of the Wyoming Valley field, which had a total annual production of approximately 40,000,000 tons in 1909, according to the report of the State Bureau of Mines, of which over 4,000,000 tons was from collieries directly abutting the river. If this coal could be loaded from the breakers to the boats and transported in large boats or in fleets down the river; across the eastern shore of Maryland, by the Delaware and Chesapeake Canal to Philadelphia and Wilmington, or to Baltimore and Washington by way of Chesapeake Bay, much of it would presumably take this route.

Most of the collieries are short distances back from the river, few of them more than a mile or two, although some are along the valleys of small tributaries, some 5 or 10 miles from the river. The coal from these mines could be hauled down by the existing railroad spurs to be dumped into storage bins which could be so elevated, owing to the high river bank, as to dump into the boats, necessitating thus no handling of the coal.

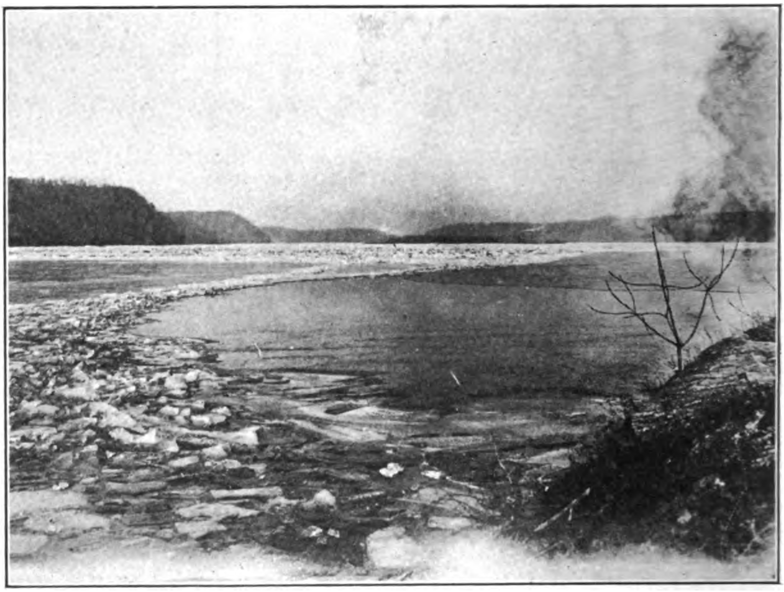
Comparing this possible 40,000,000 of tonnage with the 1907 business on the Monongahela of about 13,000,000 tons, and the commerce in the same year on the Delaware river, including domestic and foreign of 27,000,000 tons, it is evident that the possibilities of this stream are large and at least worthy of careful study and consideration.

Of course most of the tonnage would go downstream, but the river drains an area quite densely populated and up freight could be made exceedingly attractive in price. Starting at the lower end of the stream it passes among other towns, Columbia, Wrightsville, Middletown, Steelton, Harrisburg, Duncannon, Millersburg, Sunbury, Northumberland, Danville, Bloomsburg, Nanticoke, Plymouth, Wilkes-Barre, Dorranceton, Kingston, Pittston, and Scranton, having a combined total population of approximately 400,000.

An instance of one possible source of up freight is the Pennsylvania Steel Company at Steelton, which company owns iron mines in Cuba and obtains much of its ore from them, bringing it by rail from Philadelphia and Baltimore. This ore could be transferred from the ships to river barges as cheaply as it is now handled to cars, and these boats would come directly to the plant, which lies along the river bank.

The consumption of anthracite coal differs from that of bituminous coal in one respect, an important one to this subject of transportation, and that is that it is very largely used in retail lots, and is handled by dealers who purchase by the carload and sell by the wagon load, storing the coal on wharves after is is dumped from the cars, and later loaded into wagons for delivery.

Soft coal, however, is largely used by industries and is purchased by the carload and brought by the railroad immediately to the works, involving no intermediate handling. Thus in the case of anthracite coal, if the boats bring it to Baltimore for instance, it can be unloaded and stored in coal wharves along the water front, to be loaded on wagons for delivery just as in the case of that transported by railroad. There would be a little more difficulty probably at the mines in getting the coal directly from the collieries to the boats. Many of the collieries are so near to the waters edge that the coal could be dumped directly into the boats, and most of the others are so located that they could dump into freight cars and the latter run down grade to the river and dump into the boats.



Susquehanna River above McCall's Ferry Dam.

The Susquehanna or Main Line canal carried its greatest traffic during its ownership by the Pennsylvania Railroad, that of the year 1874, being 470,000 tons, 320,000 tons coming from the Wyoming Valley field, the remainder from the Shamokin and Lykins fields. The canal company was a heavy stockholder of the Susquehanna Coal Company, and a large portion of the output of the mines of this company was carried by the canal.

The railroad rate on coal from the Wyoming Valley field is now approximately 0.7 to 1.0 cent per ton mile, depending on the size, to Baltimore, Philadelphia, Washington, etc., and is lower than for most other products. If the railroad coal tonnage could be replaced by a higher grade of freight the profits would presumably be larger. The following table shows the rate on long tons from the vicinity of Wilkes-Barre to the larger eastern and southern cities which might be reached by navigation on an improved Susquehanna river.

RATES ON COAL, LONG TON, VIA PENNSYLVANIA RAILROAD—WILKES-BARRE TO

Rate per ton mile.							
P. S.	*Pea*	*Small*		*Prepared sizes*	*Pea*	*Sizes Smaller than Pea*	*Dist.*
0.93	0.8	0.7	Wilmington, Del.	1.90	1.60	1.45	203
1.0	0.8		Baltimore, Md.	2.00	1.60		200
0.83	0.77	0.7	Washington, D. C.,	2.00	1.85	1.60	240
1.02	0.86	0.8	Philadelphia, Pa.	1.80	1.50	1.35	176

If the 40,000,000 tons of coal mined annually along the river above and below Wilkes-Barre were moved to these points, the transportation thereon would amount to approximately $70,000,000 per year, at an average rate of $1.75 per long ton. Would not a good deal of this tonnage find an outlet down the river to these points if navigation was improved and the water rate made lower than the rail rate? This enormous traffic would seem to warrant a heavy expense in improving navigation, and the rates charged thereon should be controlled by the authorities which did the work. If a rate of 50% of that charged by the railroad were fixed for the water borne traffic a gross income of $35,000,000 would be insured, together with a net saving on the transportation of another $35,000,000.

Many of the larger mines are owned by coal companies controlled by the railroad companies, and it is to be expected that the output of these mines would at first continue to be hauled by rail even in the event of cheaper water freight rates. There are, however, numerous mines of large capacity owned by independent operators which are more or less under the control of the railroads, on account of their dependence upon the railroads for car service, but with a water outlet for their output this dependence upon the railroads would cease. If these independent coal operators shipped by water the price of their coal at the points reached by water would be reduced, and the railroad coal companies would be forced either to meet it through lower freight rates, or by using the waterway.

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THE HUMPHREY PUMP

By A. P. Steckel.

Read before the Society, February 13, 1911.

The name Humphrey Pump covers broadly the very recent work of Mr. Herbert A. Humphrey of London in the field of internal combustion pumps and compressors employing a liquid piston. To date there is little literature on this subject, but (London) *Engineering* of Nov. 18th, 1910, reprints a very complete paper read before the Manchester Association of Engineers by Mr. Humphrey, and the *American Machinist* of Jan. 5th, 1911, contains an article by Mr. Edward N. Trump of Syracuse giving an account of his critical inspection and tests of the apparatus at the demonstration plant at Dudley Port, England, where all of Mr. Humphrey's developments have been made. Both of the above mentioned articles give a clear statement of the whole case. The present effort on my part will be to outline the subject with the assistance of some lantern slides kindly loaned by Mr. Trump for this occasion. Only a few figures, easily remembered, will be inflicted on you this evening, with the assurance that they will be sufficiently interesting to invite a careful reading of the literature cited where you will find costs and efficiencies in particular cases clearly tabulated.

The features common to all Mr. Humphrey's apparatus are: use of a liquid piston both as piston and flywheel, internal cooling by sole means of the liquid piston, expansion of gas to or below atmospheric pressure, starting under full load by means of the spark alone, constant mixture without sacrifice of compression, immunity from injury by dirty gas, rugged simplicity, low cost of manufacture and upkeep, entire absence of parts requiring lubrication, and considerably higher overall efficiency than any other pumps or compressors however driven. This long list, embracing about everything aimed at by gas power engineers, is given right at the start to attract your careful attention to what might otherwise pass for a commonplace layout or iron pipe and a few mushroom valves.

Low Lift Pump With Drowned Suction—Fig. (1).

This particular design of pump, having as you see no discharge valves, is limited to heads of about 40 ft. and under, and consequently limited to a compression of about 60 lbs. per sq. in. You need not be told that low lift pumps in general are less efficient than those of high lift, nor that gas engines suffer in efficiency when working with low compression of charge. In spite of these handicaps this design of pump in units as small as 35 H. P. has an over all efficiency of 22% figured from thermal value of gas to water actually delivered. Regardless of size and the further advantages of high lift and most advanced development, the record for large gas pumping engines is now 22% and of steam pumping engines considerably lower. On the above basis some Humphrey pumps of 210 H. P. now under construction for the Metropolitan Water Board of London are expected to have an efficiency of 24% from gas to water raised. These pumps will have a lift of only 25 ft. and correspondingly low compression.

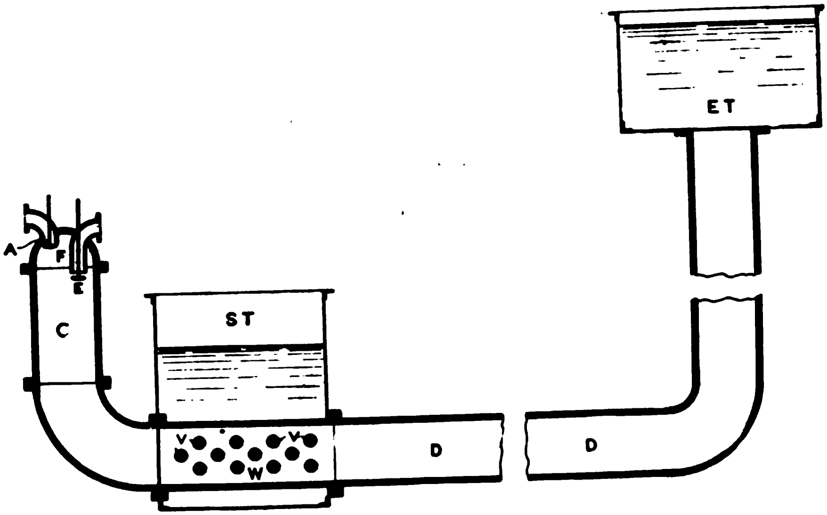


Figure 1.

Let us now study the construction and operation of this low lift type of pump. Dimensions are lacking but in the case of the 35 H. P. pump of 35 ft. lift we have a fair idea of size of all parts from knowing that internal diameter throughout is 25 in., and length between vertical sections of pipe about 65 ft. S T is the low level tank from which water will enter through valves V whenever internal pressure is low enough. A is the inlet for explosive mixture which we will always refer to from now on as gas. This valve A is normally held closed by a weak spring and a partial vacuum is required to open it and hold it open. E is the exhaust valve which falls open at about atmospheric pressure and requires a slight blow by the ascending column of water to seat it. C is the explosion chamber. F is a pocket between exhaust valve level and top of chamber. D is a horizontal pipe containing always a mass of water which serves as a flywheel and its function has aptly been explained by calling the water contained in it a liquid pendulum. Two parts not shown for the sake of clearness are a simple interlocking gear between admission and exhaust valves, also a scavenging valve requiring a slight suction to open and free to open whenever the exhaust valve is unlocked by the interlocking gear.

Imagine an explosive mixture under compression in upper part of chamber C, the remainder of pipe and tanks being full of water and all valves seated tight under a pressure of say 175 lbs. per per sq. in due to the static head of water. A spark at a plug in top casing fires the charge with a momentary pressure of about 160 lbs. per sq. in. This pressure is opposed by only about 17 lbs. static pressure and the inertia of the long column of water. The mass of water to be moved is purposely large so that its maximum velocity is low. Evidently the period of acceleration ends when the gas has expanded down to 17 lbs. pressure, at which instant the water has its maximum velocity of about 14 ft. per second. The kinetic energy of the water is then sufficient to enable further expansion of the gas on down to below atmospheric pressure when the water momentarily stands still before starting to surge backward. In this short interval of low internal pressure, more water enters through valves V, the scavenging valve on top is sucked open long enough to fill chamber F with air from outside, and exhaust valve E falls open. The body of water now returns pushing the burned products out through open valve E until the water at some speed hits and closes this valve and is brought up short by having to compress the air in pocket F. This compression causes a short backward stroke of the water column resulting in a vacuum sufficient to suck in a new charge of gas through valve A. Again the column of water returns, compressing the mixture which indirectly touches off a spark and the cycle just described repeats itself indefinitely. The device for timing the spark resembles an engine indicator, consisting of a small piston acting against a spring. It is adjusted so that it sets off the spark at maximum compression pressure. Here it must also be explained that the interlocking rig mentioned before accounts for the exhaust and scavenging valves opening only near end of power strokes, and gas admission valve opening only near end of cushion strokes. The interlocking device is simple enough, being nothing but a sliding latch pulled back and forth by the motion of the valve stems through the medium of several weak springs. A complete movement of the exhaust valve down and up slides the latch so as to lock this valve and unlock the admission valve. Similarly a complete motion of admission valve results in locking itself and unlocking the exhaust and scavenging valves.

Very evidently the action ceases upon opening the spark circuit, and pumping is resumed upon closing this circuit, for a compressed charge is always left in the explosion chamber. If the valves are not absolutely tight and the pump has stood long enough to fill up with water, a charge of compressed air filling chamber C and suddenly released by opening exhaust valve with a hand lever, thus reproducing the exhaust stroke, is all that is required to start up again against the full head of water.

The few Americans who have seen the pumps in operation testify that operation is noiseless with the exception of a gentle click of gas valves and interlock and a faint thud at instant of explosion. Presumably this latter noise would be audible in any gas engine if other and louder noises were not always present to drown it out. The same testimony applies to starting without fail from a small switch at any distance and reaching full speed in ten seconds after start from standstill. Naturally the exhaust at atmospheric pressure is a mere hiss and the exhaust is fairly cold for the same reason.

Before passing on to the consideration of larger pumps and those designed for heads of over 40 ft., it may be well to go back to the long list of virtues previously mentioned, pointing out just how each has been realized. Comparison with the most efficient rival, the gas driven pumping engine, is interesting.

The water piston, considered simply as a piston, needs no rings to make it fit, no tail rod and cross heads to relieve weight from bore of cylinder, no connecting rod to connect up with work to be done, no swinging joints to carry cooling water in and out, cannot cause wear on the cylinder, and costs absolutely nothing to build or maintain.

As a flywheel it fulfills its purpose with small loss because a proper length and diameter of play pipe keep velocity of water within the limits of good practice in the more familiar case of city mains.

As a cooling agent the water touches the spot to be cooled and gets there in advance of the heat. The evaporation of a thin film of water really prevents much heating of walls and thus does away with fatigue of cylinder material. Contrary to usual snap judgment, the loss of heat per sq. unit by this direct application of water does not exceed that of usual practice.

The gas cycle is the ideal one that we have read about in text books but have never before encountered in practice. A possible exception is the so-called complete expansion gas engine which takes in only half a cylinderfull of gas and so exhausts at lower than ordinary pressures. Added weight per H. P. in an engine already very heavy for its output, without reduction of internal losses, has neutralized the apparent economy of this type of engine.

It is admitted that compression in the low lift pump is limited to about three times that of the static head, but this limitation does not apply to the high lift type, at any rate this handicap is partially offset by absence of discharge valves with the result that an efficiency of 24% is counted on in the largest pumps of this type with lift of only 25 ft.

Starting against a full head of water with the spark alone, assisted in the worst case by a hand pump to supply a few cubic feet of air at low pressure, compares favorably with the use of considerable high pressure air to turn over a large gas engine at no load.

In engines having clearance inherently fixed, the use of constant mixture means low compression in the case of small charges. In Mr. Humphrey's apparatus, other things being equal, a small charge is compressed to a higher point than a larger one because a definite amount of energy and not a definite volume limit the compression.

As to a reasonable amount of fine dirt in the gas, no part but the admission valves need suffer and dry cleaning of the dust catcher sort is said to be all that is required. This certainly sounds attractive when rotary wet scrubbers of the best design are necessary for engine gas and are being strongly recommended for treating gas to be burned under boilers and in hot blast stoves. Gas cleaner than air is the present requirement in our gas power plants.

The claims of general simplicity, freedom from need of lubrication, and low cost of upkeep and what has been called reliability insurance, seem too well grounded for more than passing mention.

The matter of first cost is very favorable to the Humphrey apparatus and will be considered by itself after we get a better idea of all the types.

Low Lift Pump Showing Indicator Card—Fig. (2).

The interesting feature here is the indicator card, which for want of a crosshead has to be taken on a straight time basis, by means of clockwork. The enclosed area has no particular relation to work done; but compression, time element of ignition, expansion to a vacuum, cushion pressure higher than explosion pressure, and subsequent expansion to a vacuum, are all shown as clearly as the use of a strong spring will allow. The cycle in this case takes almost 5 seconds but a large volume of water is handled per cycle. Rather slow speed is characteristic of the low lift pumps, partly to allow time for the large volume of water to enter easily, and partly to keep down the wetted surface losses to a proper percentage of the relatively small total power. In the case of high head pumps, speeds of over 50 strokes per minute are permissible, and the present case of only about 13 cycles per minute must be regarded as the low limit of the low lift type.

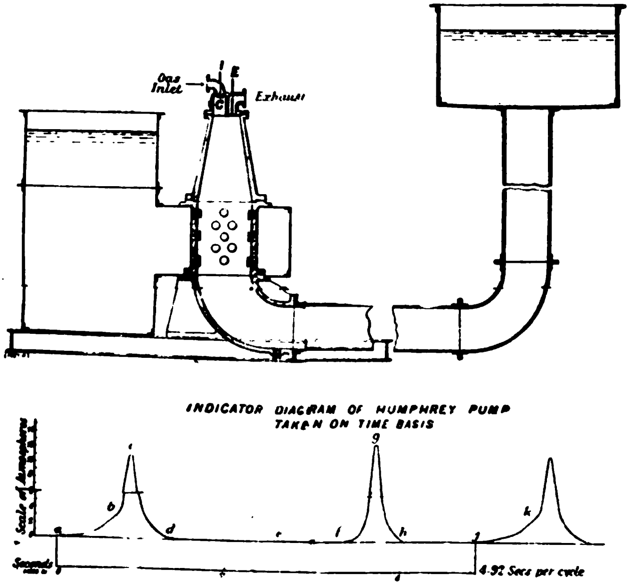


Figure 2.

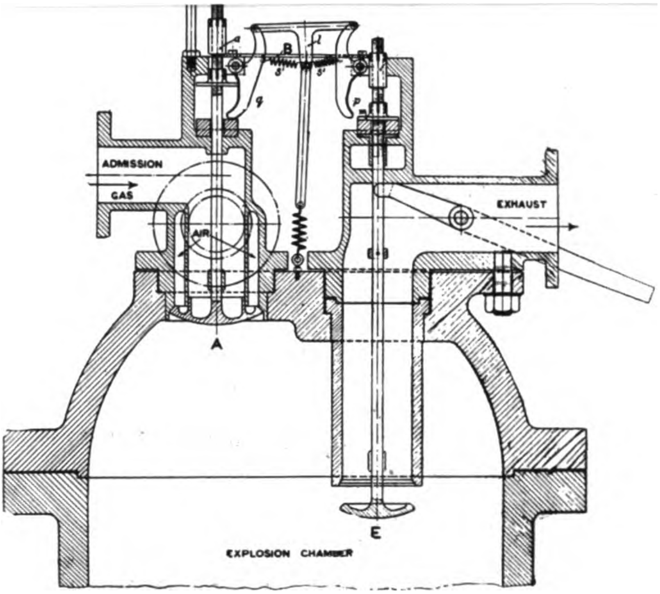
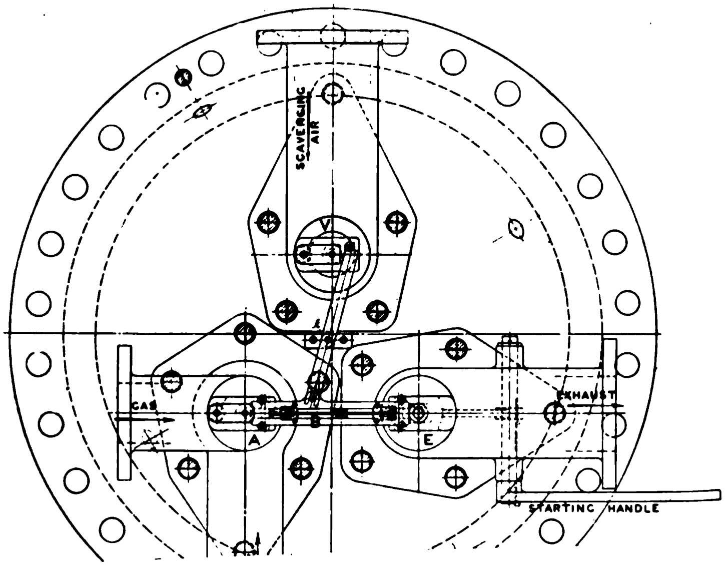


Figure 3.

Two Views of Interlocking Gear—Fig. (3) and Fig. (4).

These two views of the interlocking gear, characteristic of the four cycle pumps, are shown merely to give an idea of its appearance.



Three Views of Brussels Pump—Fig. (5), Fig. (6) and Fig. (7).

The next three views give a fair idea of the appearance of a 35 H. P. low lift pump that received the highest award as a gas engine at the Brussels Exposition last summer. It was similarly treated by the judges as a pump, which seems less remarkable in view of its startling economy in raising water. The play pipe is curved about for the sake of compactness. This is always possible.

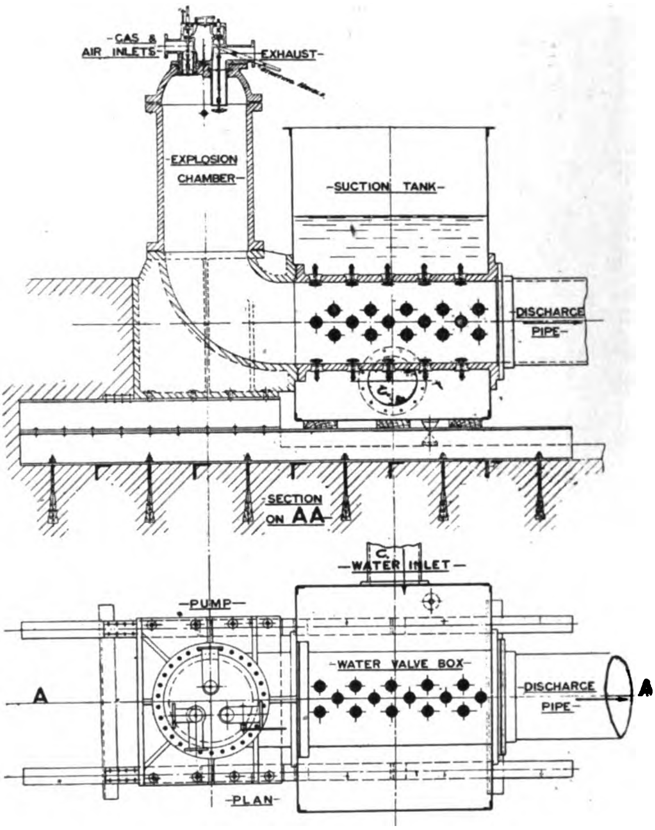


Figure 5.

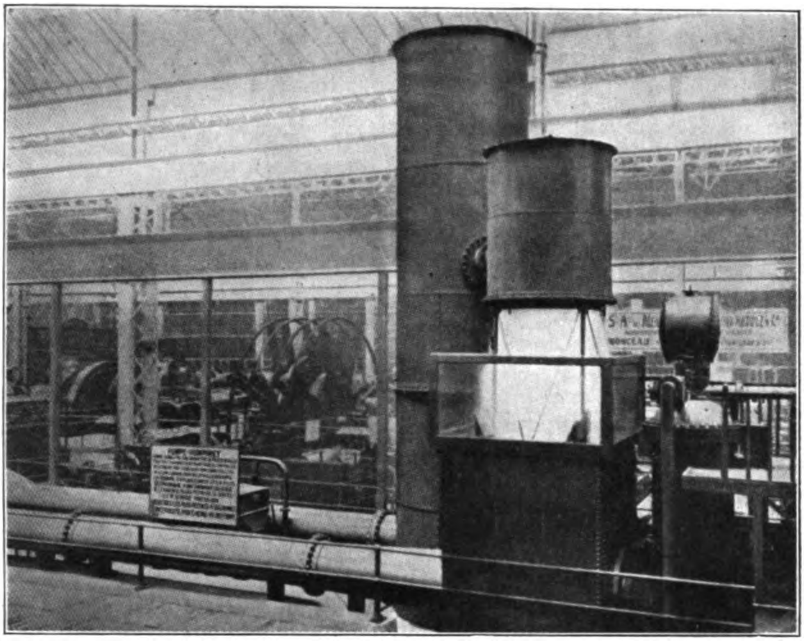


Figure 6.

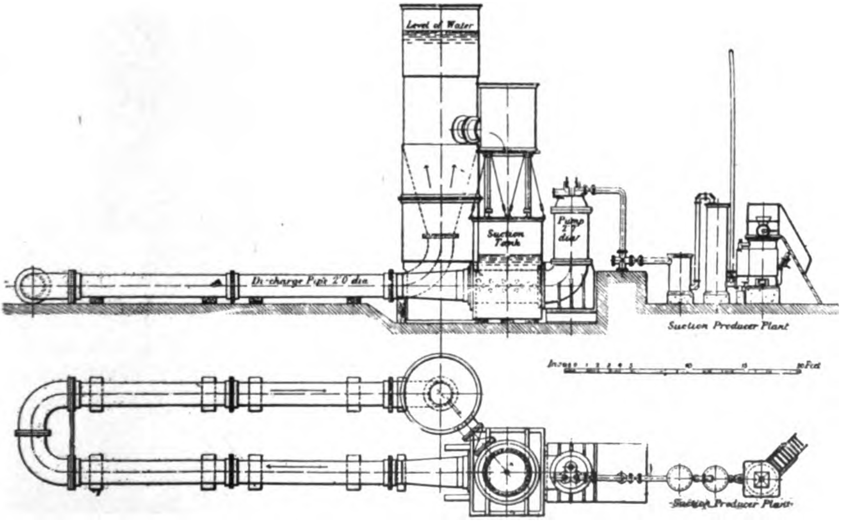


Figure 7.

Photograph of Explosion and Suction Chambers—Fig. (8).

This is all there is to the low lift pump if we neglect the play pipe and stand pipe. The play pipe, although essential to proper working, leads the water off in the desired direction, so can not properly be charged entire as part of the pump. It is always larger of course than the main leading the water away from the stand pipe but the difference in weight is all that is properly chargeable to the pump installation.

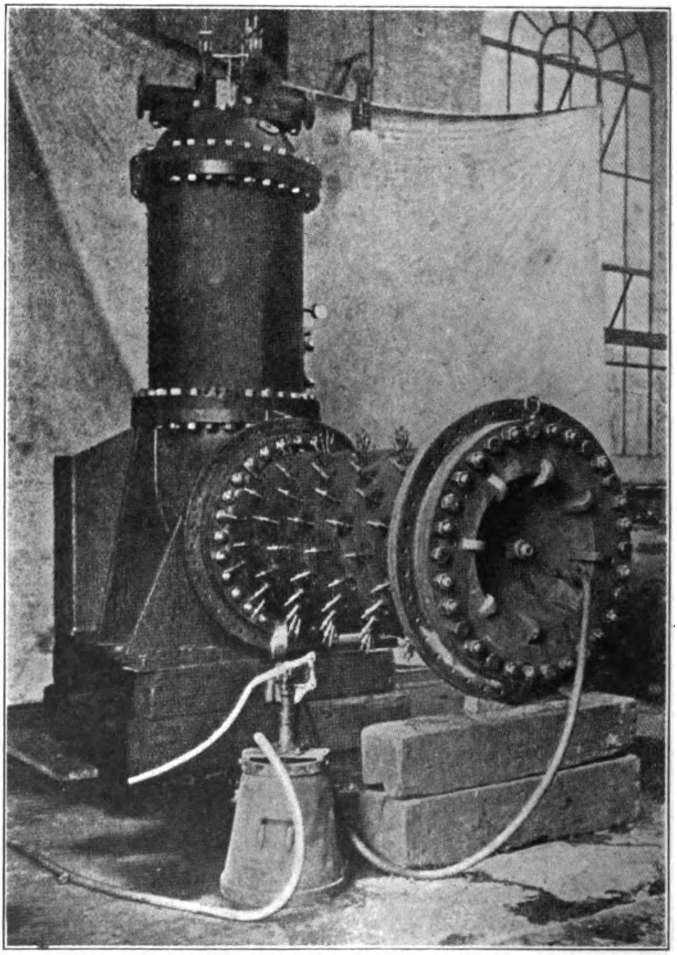


Figure 8.

Photograph of Play Pipe and Stand Pipe at Testing Station—Fig. (9).

This is a view of some permanent piping at the English testing plant.

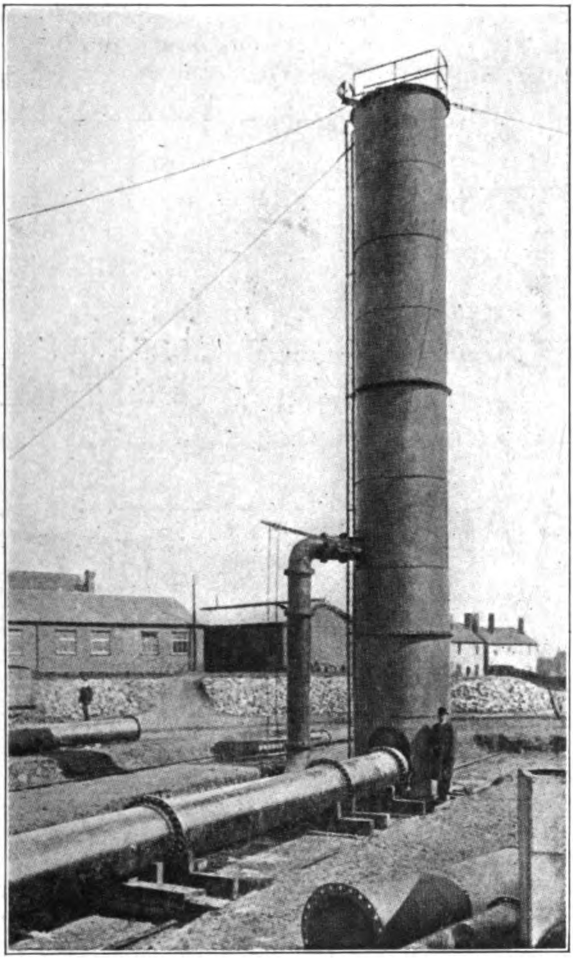


Figure 9.

Cross Section of Metropolitan Station—Fig. (10).

This installation, under the authority of the Metropolitan Water Board of London, is to consist of four Humphrey pumps each of a capacity of 48,000,000 gallons per 24 hours, and a fifth pump of 24,000,000 daily capacity. The lift is only 25 ft. which is well adapted to the use of centrifugal pumps and direct coupled high speed engines. However from actual bids for the whole station including pumps, steam engines of high speed (350 r. p. m.), boilers, producers, buildings, foundations, etc., the saving to the Board by adoption of the Humphrey pumps amounted to $95,000 in first cost, a saving of half the coal required for triple expansion steam engines, and a clear saving of some considerable amount annually in attendance, maintenance, and repairs. If we balance the additional first cost of triple expansion engines against the first cost of additional boilers necessary with simple engines, the former would seem to give the cheaper plant regardless of efficiency. High speed gas engines direct connected to centrifugal pumps are also said to have been considered.

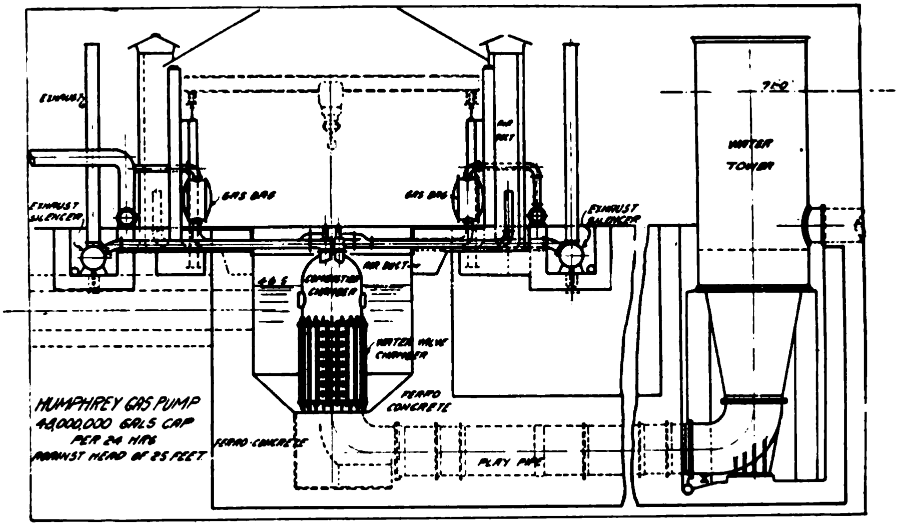


Figure 10.

So far as this view goes the pumps simply look larger than those we have seen before. Using the head as a basis for scaling, the diameter of play pipe would seem to be about 6 ft. The length of play pipe (here shown broken) is in the neighborhood of 60 ft. The provision for unbalanced thrust at the cylinder end of play pipe is worth mentioning.

The question of possible contamination of drinking water by this method of pumping has been answered by a disinterested English chemist who reports that he had to circulate the water under test about 100 times before he considered the water to be objectionable for drinking purposes.

Diagram of Low Lift Pump and Stand Pipe—Fig. (11).

This is one of four general schemes for using the low lift pump without provision for suction lift and is one we have been considering thus far.

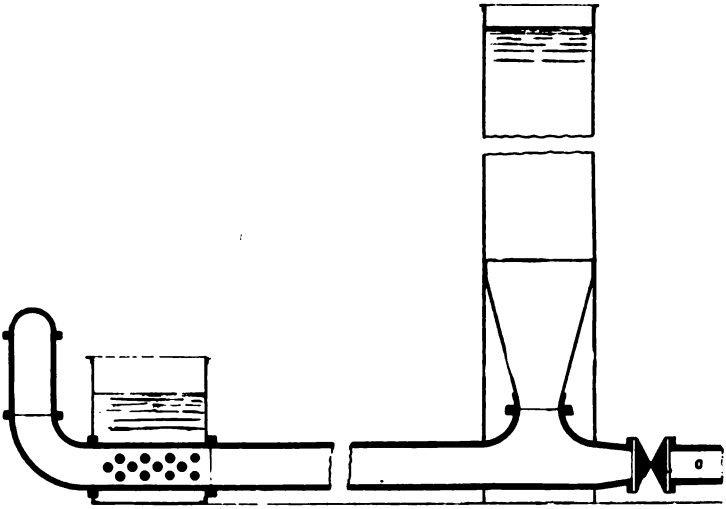


Figure 11.

Low Lift Pump With Air Vessel—Fig (12).

In this case an air vessel is substituted for the stand pipe.

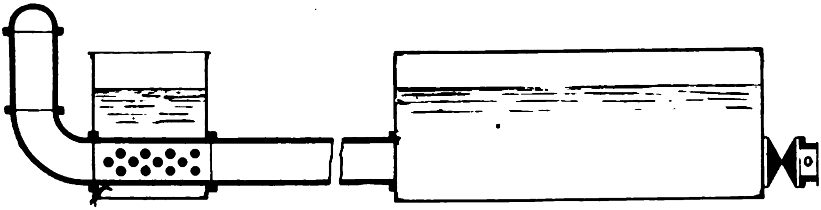


Figure 12.

Low Lift Pump With Diagonal Play Pipe—Fig. (13).

This arrangement may be more economical to install in some cases.

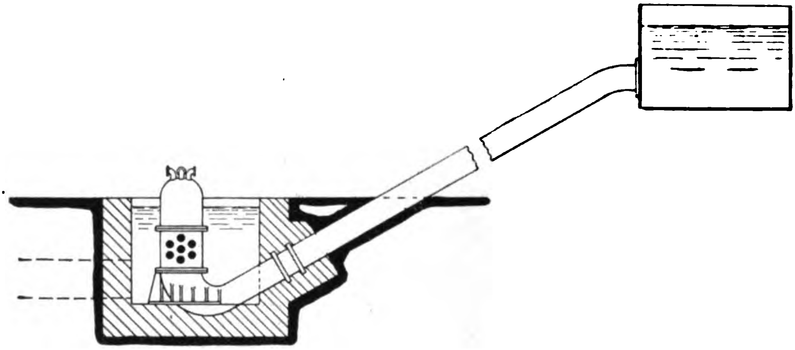


Figure 13.

Low Lift Pump With Drowned Suction Pumping from Well—Fig. (14).

This sort of arrangement is contemplated for certain cases of pumping from wells without actual suction lift.

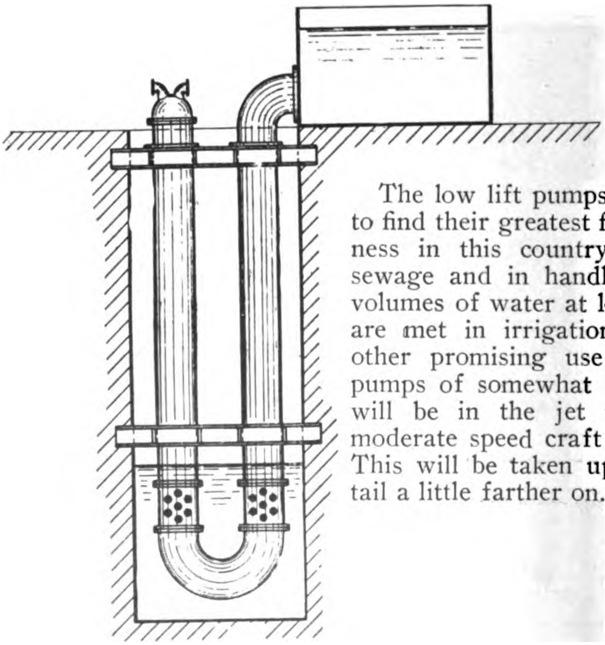


Figure 14.

The low lift pumps are supposed to find their greatest field of usefulness in this country in handling sewage and in handling the large volumes of water at low heads that are met in irrigation work. Another promising use for low lift pumps of somewhat special design will be in the jet propulsion of moderate speed craft of large size. This will be taken up in some detail a little farther on.

Low Lift Pump With Two Explosion Chambers—Fig. (15).

This is a modification applying equally well to both low lift and high lift pumps and will be explained when we take up forms of the high lift pump. It is sufficient to say that the use of the two explosion chambers firing their charges alternately does away with the idle cushion strokes in the play pipe, greatly increases the capacity, and makes expansion below atmospheric pressure unnecessary so far as taking in a new charge is concerned.

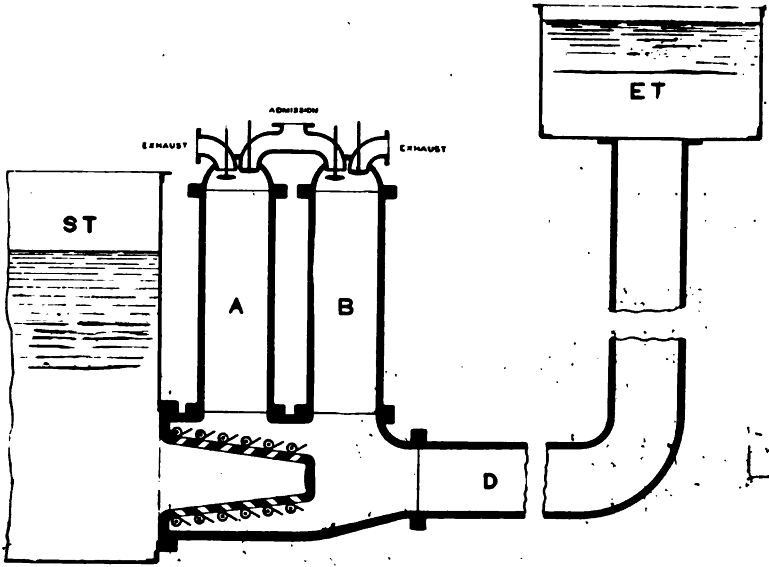


Figure 15.

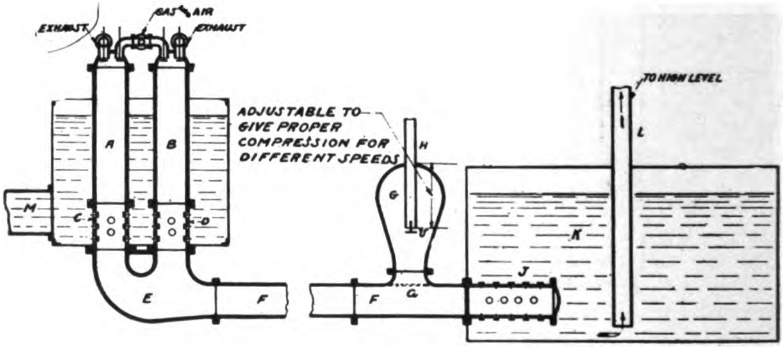
Before going on to the high lift pumps and compressors it may be well to discuss briefly one vital point that may seem to have been too confidently accepted. This is the matter of expansion down to a partial vacuum at the end of power and cushion strokes. In a great many cases the valve action depends on this so it is a vital matter. Without much analysis it is apparent that in the case of low lift pumps, a given head must not be attempted unless the mean effective pressure of the gas, in a stroke long enough to end with the desired low pressure, exceeds the static pressure by sufficient margin to make good the losses. In the case of the cushion rebound, the question narrows down to the water receding from the cushion as fast as it strikes the cushion, and this it will do with a small allowance for loss. In practice there is always ample margin in the matter of having a long enough cushion rebound to draw in the desired charge, so our first impression of lack of positive action is not justified at all.

Another interesting and practical point is, that a pump normally working near its maximum lift will behave well if the head is decreased, without any adjustment from without. Having less resistance from the static head, there is a longer power stroke. There is less force to accelerate the liquid pendulum on the return stroke, hence more water has time to enter. Consequently the pump is simply handling more water against a low head per stroke without any adjustment, which is what we would want it to do.

Any misgivings as to heat economy by direct cooling seem to be met by the overall efficiency. No data is available giving heat contained in exhaust gases or heat absorbed by the water so we cannot for the present say anything definite about distribution of the losses.

Double Barreled High Lift Pump—Fig. (16).

This is the pump we saw before except that the two explosion chambers firing alternately do away with the time consuming cushion strokes, and the combination of air dome and check valves at far end of play pipe make up an efficient and smooth acting ram, which enables the pump to deliver water against any head however high. The ram may be used in connection with a single explosion chamber, or two explosion chambers may be used on low lift pumps. Considering first the two explosion chambers A and B. They are identical in design with those used singly, except that the cushion space above level of exhaust valve is very small, hence no scavenging valve is employed. The reason permitting this smaller cushion will appear presently. Taking for granted for the present that there will always be a return stroke after every outward stroke, consider A as full of water and B as containing a compressed charge of gas in its top. Firing this charge drives the water downward in B and outward in the play pipe until pressure is low enough to admit more water through



NOT TO SCALE

DIAGRAM OF TWO CYCLE, TWO BARREL, HUMPHREY PUMP WITH INTENSIFIER FOR HIGH PRESSURE

Figure 16.

the valves C and D. At so low a pressure the water filling A falls from the top and positively draws in a new charge of gas. The return surge in play pipe meets least opposition by rising in B and pushing out the burned products through the open exhaust valve; and, this completed, compresses the charge in A up to the firing point, which starts the same cycle with the functions of A and B turned about. It is now clear that only a small pocket of spent gas is required in the top of each chamber to form a cushion, for the only water to be stopped is that in the chamber itself. This accounts for the absence of scavenging valves. A noteworthy feature here is that the new charge is drawn in positively by the falling of the water, and not by a rebound from a cushion.

The action of the ram intensifier is as follows: Outward motion of water in the play pipe, under no pressure for the present, causes water to rise in air dome until it closes the air escape valve v, after which pressure of entrapped air in G rises to a point where check valves J open and allow water to pass into air vessel K which may be under any pressure however high. This goes on until the water has lost all its kinetic energy and is at rest with the valves just seated, when the compressed air expands again and causes the back stroke, valve v falling open as soon as the water leaves it and remaining open for the free passage of air until it is closed again on the next outward stroke. Neglecting losses, it is evident that the energy spent in compressing air in the dome on one stroke reappears in compression of the charge for the following stroke. Also, the amount of energy thus allotted to compression of charge depends simply on the volume of air entrapped, so that lowering the adjustable dip pipe H raises the compression to any desired point, a feature not found in the low lift pumps.

Same As Above But With Chambers Exposed—Fig. (17).

This is the same idea as the last one except that explosion chambers are not submerged in the low level tank.

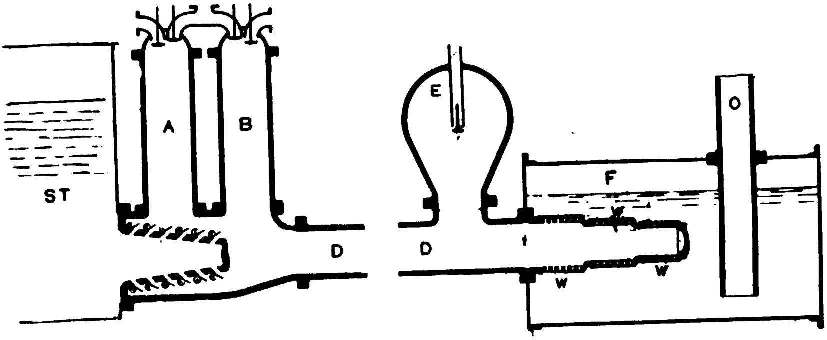


Figure 17.

German Pump—Fig. (18).

High heads, high compression, large power in single units, all make for high efficiency, so that Mr. Humphrey's associates in Germany who are building a 1,400 H. P. pump for 200 ft. head are confident of realizing a thermal efficiency of 34% from the gas to water delivered. Here are all the elements previously shown in diagram and the principal dimensions of a similar high lift pump are given. The speed will be high, over 50 cycles per minute. It is to be used in connection with a water turbine to drive a 900 K. W. electric generator and the whole combination will occupy no more floor space than a gas engine and generator of equal power. Although a partial length of play pipe is shown as 39 ft. it must be remembered that the pipe is curved about to save space. Assuming only 30% efficiency for the pump and 80% for the turbine we have a combined efficiency of 24% to compare with about the same figure as a high record for the largest gas engines. These assumed efficiencies for pump and turbine are conservative, so that considerably higher efficiency is in sight under chosen conditions. Where such considerations as low first cost and low cost of attendance and repairs seem to weigh so heavily against the large gas engine, as we know it, hair splitting on thermal efficiency would seem out of place. As soon as the promised merits of the pump are well demonstrated, the combination of pump and tur-

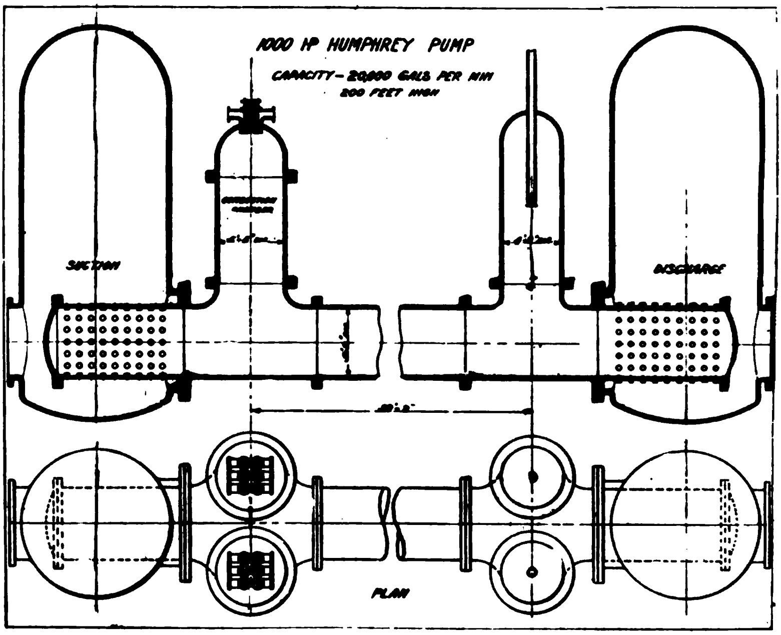


Figure 18.

bine should fill a long felt want as a rugged sort of gas engine. The free choice of type of turbine should favor the Francis type where fairly high speed and compactness are wanted, and the Pelton wheel should work in well for low speeds. A very attractive feature of this sort of engine is that its starting torque is twice its full load torque with normal water pressure and still higher momentary starting torque is available by raising the water pressure. This is a very radical departure, but the pump itself is the only part requiring real pioneer development, and it is being developed by German engineers whom we are bound to respect on their past record. Mr. Humphrey and his English associates have to date made good their original predictions on performance of all apparatus so far developed, and are taken very seriously by the best informed of their fellow countrymen, as favorable comment of the leading English engineering journals amply proves.

Two Cycle Pump—Fig. (19).

Unfailing expansion down to a partial vacuum, with resulting low exhaust temperature, have enabled Mr. Humphrey to reach a simple solution of the two stroke cycle with the simple design here shown. Here every downward stroke is a power stroke and the vacuum at end of strokes takes care of drawing in scavenging air and gas in the order named. Admission valve A is ported so that in the act of opening it admits some air, and when opened farther it admits gas. The explosion chamber B is relatively long and small in diameter, widening out at the level of the exhaust valves E. The action is as follows: With all valves seated under compression pressure, the gas is fired and expands to below atmospheric pressure. Light check valves, shown as loose on stems of exhaust valves, prevent a return of spent gas at this moment, but the valves E fall open, as well as admission valve A which admits some scavenging air and then gas sufficient to fill chamber B before valve A is closed by its spring. The returning water pushes

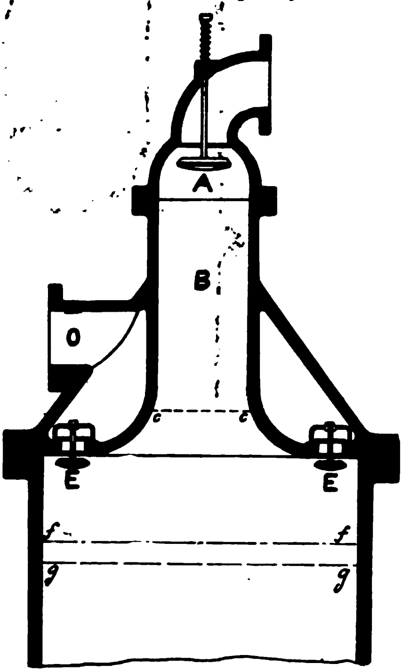


DIAGRAM OF 2 CYCLE HUMPHREY PUMP

Figure 19.

the burned products out through valves E, closes these valves, and continuing upward compresses the charge and fires it thus starting the same cycle. No interlock is required here because all valves must open whenever the pressure falls. The contracted end of explosion chamber, made possible by use of a liquid piston, serves to reduce to a minimum the zone of doubtful mixture and also furnishes an ideal place for the exhaust valves.

Two Cycle With Center Exhaust—Fig. (20).

This is a refinement of the two cycle idea in that admission is through a great number of smaller valves of large total area, so that the resulting low velocity of entering gas gives the gas a very definite boundary, a vital matter in two cycle work. The narrow annular chamber still farther insures this definite boundary. This two cycle idea should develop to give high economy, especially where a constant volume of charge is used.

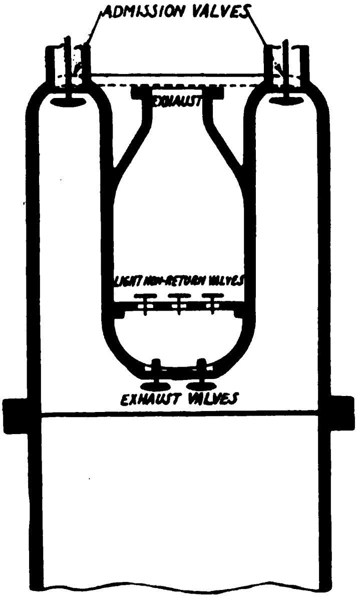
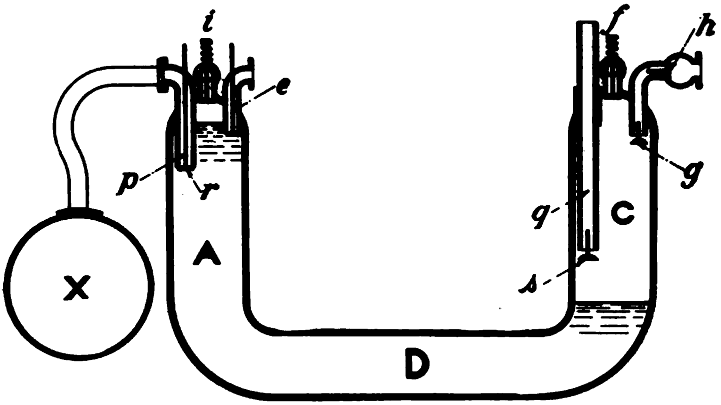


DIAGRAM OF TWO CYCLE HUMPHREY PUMP

Figure 20.

Compressor in Diagram—Fig. (21).

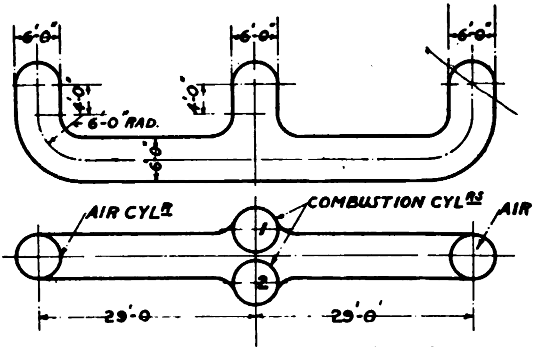
It would be difficult to condense or make clearer Mr. Humphrey's own published statement as to compressors, so the following is quoted verbatim from his recent paper as given in *Engineering* of Nov. 18th, 1910.



HUMPHREY GAS PUMP COMPRESSOR

Figure 21.

General Dimensions of Blowing Pump With Horizontal Play Pipe—Fig. (22).



TWO HUMPHREY COMPRESSORS OF THE DIMENSIONS SHOWN WILL COMPRESS 25,000 CUBIC FEET OF FREE AIR PER. MINUTE TO 25 LBS. PER. SQ. INCH. TOTAL H.P. 1510

DIAGRAM OF HUMPHREY COMPRESSORS

Figure 22.

U Shaped Blowing Pump—Fig. (23).

This is a projected design of blowing engine and the definite figures given would alone furnish material for some hours of discussion. Points well worth mentioning in a limited time are, that confidence in the two stroke cycle is apparent, small floor space per H. P. with low pressure seems phenomenal, vital parts are light in weight and easy of access, to say nothing of high efficiency, and intelligent provision for the actual working conditions of blast furnaces. All told, after being now accustomed to the gas blowing engine, this seems suggestive of a return to the *Simple Life.*

Single Barrel High Lift Pump With Suction—Fig. (24).

So far the matter of provision for actual suction lift has not been explained, but this view of a single barreled high lift pump with suction lift gives an idea of one of the ways open to development. Here the vacuum at end of expansion of the air in the dome is used to draw in water for the next stroke.

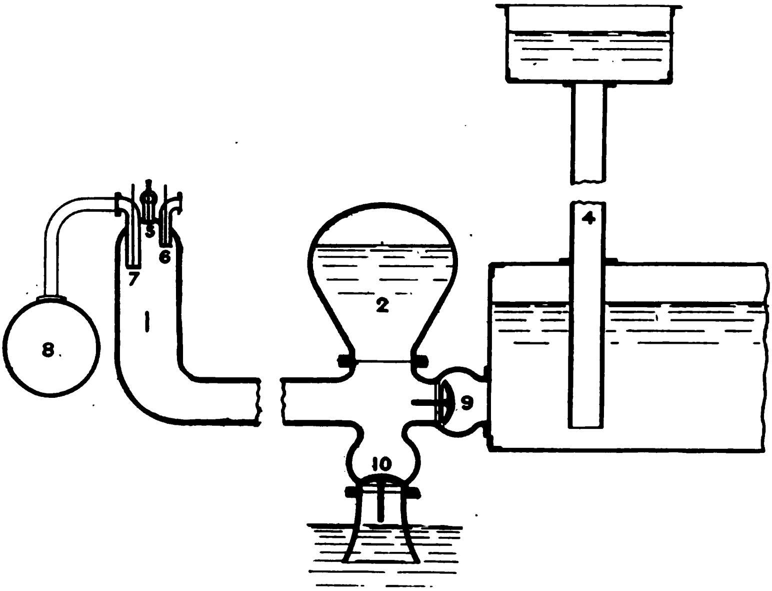
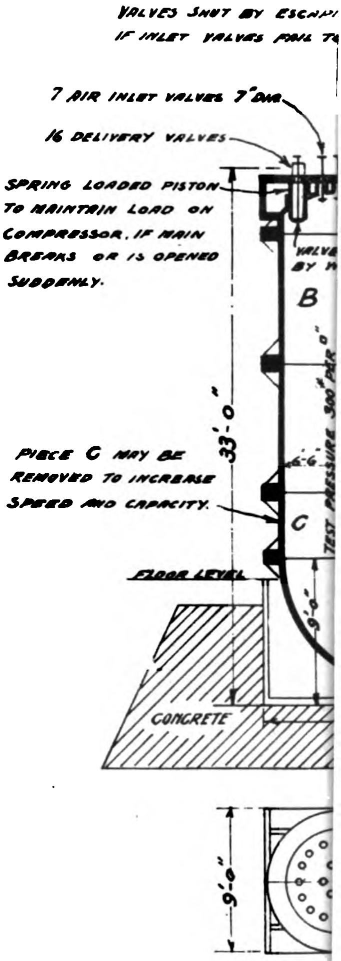


Figure 24.

HUMPHI

CAPACITY }
DOUBLE UNIT }


VALVES SHUT BY ESCAP
IF INLET VALVES FAIL T
7 AIR INLET VALVES 7" DIA.
16 DELIVERY VALVES
SPRING LOADED PISTON TO MAINTAIN LOAD ON COMPRESSOR. IF MAIN BREAKS OR IS OPENED SUDDENLY.
VALVE
BY W
B
33'-0"
TEST PRESSURE 300# PER □"
6'-6"
PIECE C MAY BE REMOVED TO INCREASE SPEED AND CAPACITY.
C
FLOOR LEVEL
9'-0"
CONCRETE
9'-0"

ESTIMATED GAS C

CYCLES PER M
GAS PER CYCLE
GAS PER MIN.

Double Barreled High Lift Pump With Suction Lift—Fig. (25).

This is exactly the same scheme as the one preceding but the pump shown has two explosion chambers instead of one.

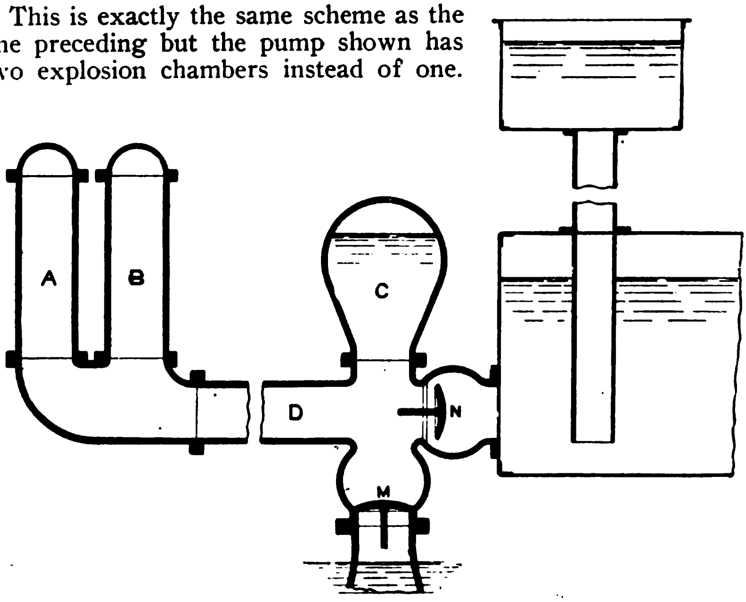


Figure 25.

Low Lift Pump With Suction, and Explosion Chamber at Lower Level—Fig. (26).

This is a curious form of pump which is essentially a low lift pump but enables higher than ordinary compression. Without going too far into details it is sufficient to say that the lower section of pipe, to left of intake valve, is larger in diameter than the remaining section marked b to the right and upward. Carrying the same volume of water on the upward stroke, the velocity of water in b is bound to be higher than the

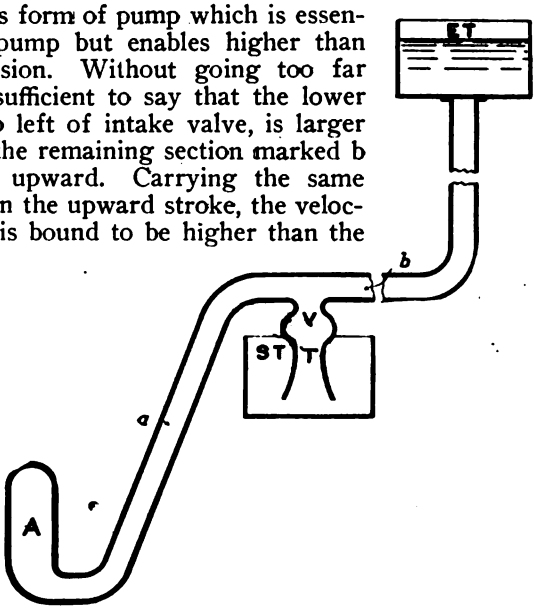


Figure 26.

velocity in a. Hence there is quite a period during retardation when the water in b is still going upward while the water in a is standing still or falling, and drawing water in through V is a result of the vacuum thus produced.

Diagram of Low Lift Pump in Marine Propulsion—Fig. (27).

The idea of jet propulsion may at last be taken seriously since a combined pump and engine of high efficiency are now to be had. Efficiency of jet propulsion is high if a large volume of water at low velocity is used, as against a smaller volume at high velocity. The low lift pump so installed as to do away with the usual unbalanced force is here shown. The double barreled low lift pump with explosion chambers A and B draws in water from both sides of boat equally, thus neutralizing any unbalanced outside forces due to suction. Similarly the direct discharge of the pump is equally divided fore and aft by pumping into air vessels E and F which communicate through pipe J. A sufficient volume of air, either in the air vessels or conveniently placed to answer the same purpose, insures a practically even propelling effort. Specially designed rudder, and accessories considered quite feasable, take care of steering and full speed reverse. Mr. Humphrey estimates that in the case of moderate speed cargo steamers the use of his pump with jet propulsion will easily double the radius of action now possible with any existing means.

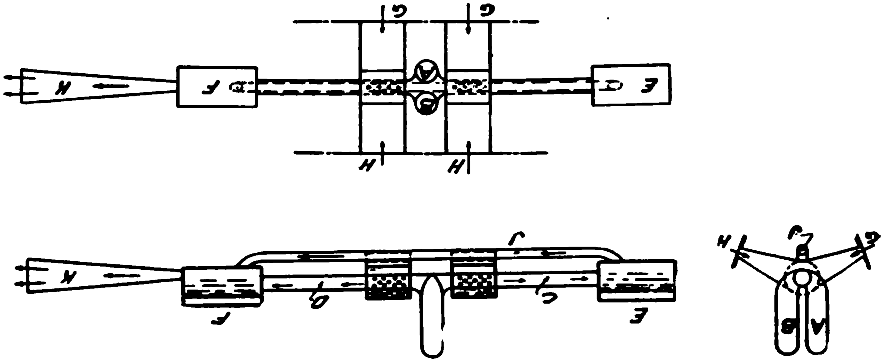


Figure 27.

Card of Otto Cycle and Comparison With Efficiency of Pump Cycle—Fig. (28).

The familiar Otto Cycle needs no explanation and the superior efficiency of the Pump Cycle as shown by the curves is explained

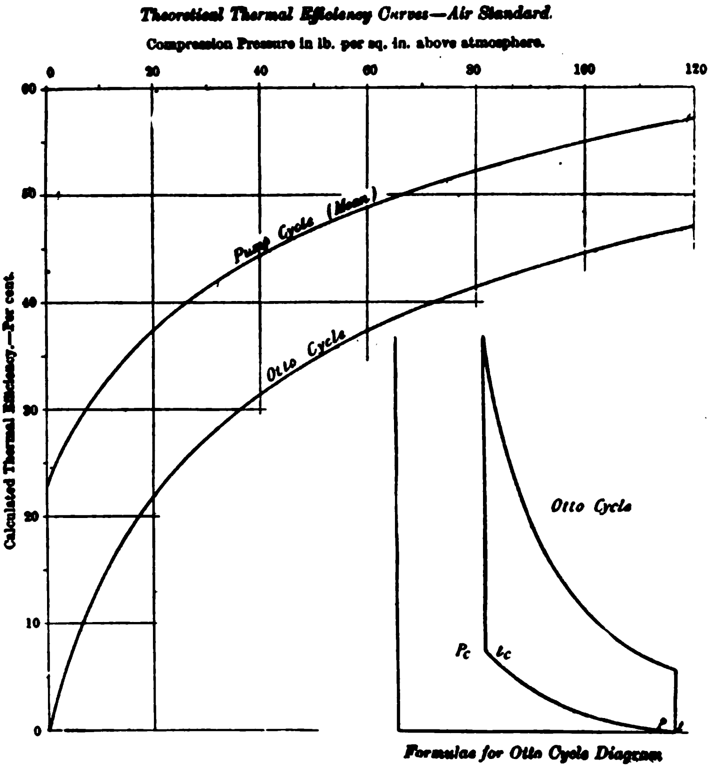
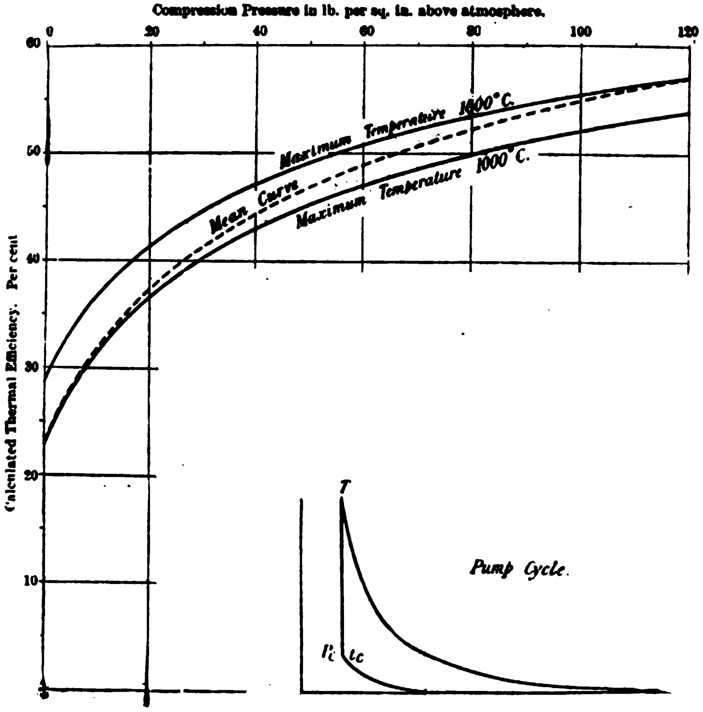


Figure 28.

by inspection of the card of Pump Cycle in Fig. (29). The Pump Cycle differs from the Otto Cycle only in the matter of expansion beyond the suction volume. The additional area of card represents additional work for a given amount of gas assuming that the cards are otherwise alike.

Theoretical Efficiency Curves, Pump Cycle, Air Standard.



Formulae for Pump-Cycle Diagram.

Figure 29.

Comparison of Practical Efficiency Curves—Fig. (30).

Based on pressures and temperatures actually realized in practice and allowing for heat lost in exhaust Fig. 30 shows a comparison between efficiencies of the two cycles for various compression pressures.

Fig. 18.—British Thermal Units per i.h.p. hour. Calculated from 0·71 of Air Standard.

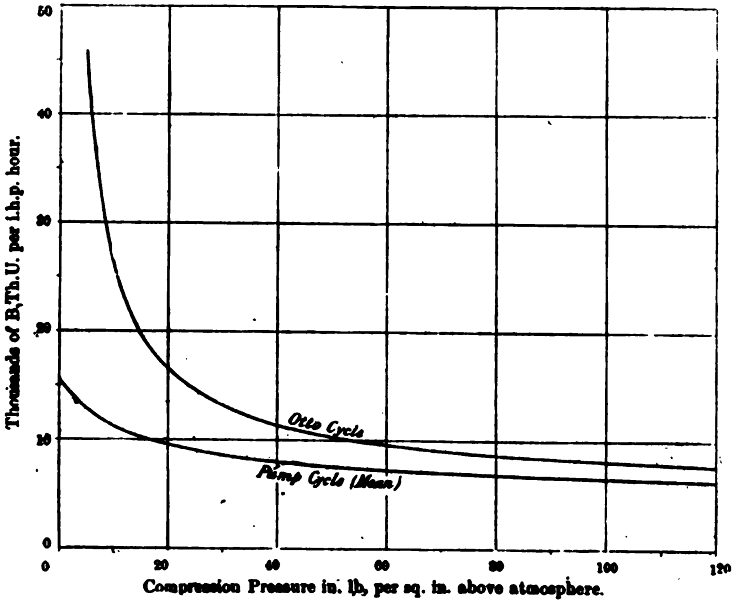


Figure 30.

TABLE OF COMPARATIVE SELLING PRICES.

Based on Commercial Estimates in the United States.

Type of Pumping Unit.	Capacity, U. S. Gallons, per 24 Hours.	Total Head, Ft.	Water, H. P.	Total Weight, Pounds.	Selling Price, Complete.	Comparative Prices. Cents per Pound.	Comparative Prices. Dollars, Water H. P.
Steam.							
1893 Compound	15,000,000	126	330	211,000	$27,000	(12.8)	1893 $82.00
1909 Compound	25,000,000	162	550	644,000	65,000	10.1	118.00
Gas Engine.							
1910 Direct Acting	15,000,000	162	395	600,000	65,000	10.8	
							164.00
1910 Humphrey, High Lift	28,800,000	200	1,000	304,000	30,400	Av. 10.5	32.00
Low Lift	48,000,000	25	210	179,000	18,800	10.5	90.00
Steam.							
1910 Twin Cylinder	10,000,000	80	140	180,000	17,500	9.7	120.00
(Competing Estimates)							
	10,000,000	80	140	220,000	14,200	6.5	101.00
	10,000,000	80	140	230,000	16,650	7.25	119.00
	10,000,000	80	140	175,000	13,765	7.85	98.00
1910 Compound	12,000,000	80	168	205,000	19,600	9.6	140.00
1911 Humphrey	10,000,000	92	160	80,360	6,600	Av. 8.2	41.25

This table confirms any ideas you may have formed by this time as to relatively low cost of the Humphrey apparatus. Remembering that the Humphrey pumps are here put in at the high pound price of 10.5c per lb. against much more expensive pumps of lower pound price, you get a fair idea of their light weight, and an impression that the pound price of 10.5c could be still cut 50%, from the character of material and workmanship that enter into them.

Two things remain to be briefly discussed. First is the suction life. A number of feasable schemes, satisfactory in present small units, have been shown. Their development in larger sizes may be expected in due course where pumps with drowned suction are not desired for one reason or another.

FIG. 17.—*Practical Efficiency Curves.* 0·71 *of Air Standard.*

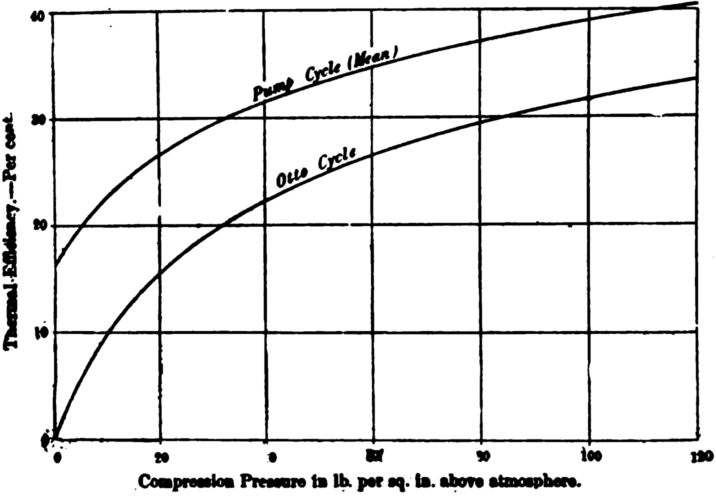


Figure 31.

The other question is that of the difficulties to be expected in the development of large units in general. Since increased thickness of cylinderwalls, attending increased diameter of cylinder, has no limit imposed by transmission of heat, the diameter will not be limited as it now is in the large gas engine. Also, the moving parts, being mushroom valves, will be multiplied rather than enlarged, so that troublesome questions of inertia will be avoided rather than solved. It is difficult to see any reason why unit stresses in any part should set a limit in the enlargement of pumps or compressors.

THE ST. LOUIS MUNICIPAL BRIDGE.

BY HENRY W. HODGE.

The new bridge being constructed by the City of St. Louis over the Mississippi river will consist of three of the longest simple truss spans ever constructed, and a short description of it may, therefore, be of interest to engineers.

After considerable discussion, it was decided to place this bridge about one mile below the present Eads Bridge about opposite Chouteau avenue, in St. Louis, and at this point the distance between the established harbor lines is just 2,000 feet. The Government required that the shore piers for this structure should be outside the harbor lines, and their only other requirement was that the bridge should have a clearance of 65 feet above extreme high water or approximately 105 feet above low water, and that it should consist of not less than three spans, and that the false work should not be placed under more than two of these spans at one time. These conditions enabled the designers of the bridge to use simple truss spans, instead of a cantilever, which is usually necessary to avoid interfering with navigation by false work.

The main span 668 feet long and 110 feet deep on centers, will be much longer than any independent truss span yet built, and will be 68 feet longer than the center span of the Quebec Bridge which although not completely erected was the longest simple span ever fabricated.

NOTE.—The Editors wish to acknowledge the courtesy of the Engineering Record in allowing the use of several illustrations included in this paper.

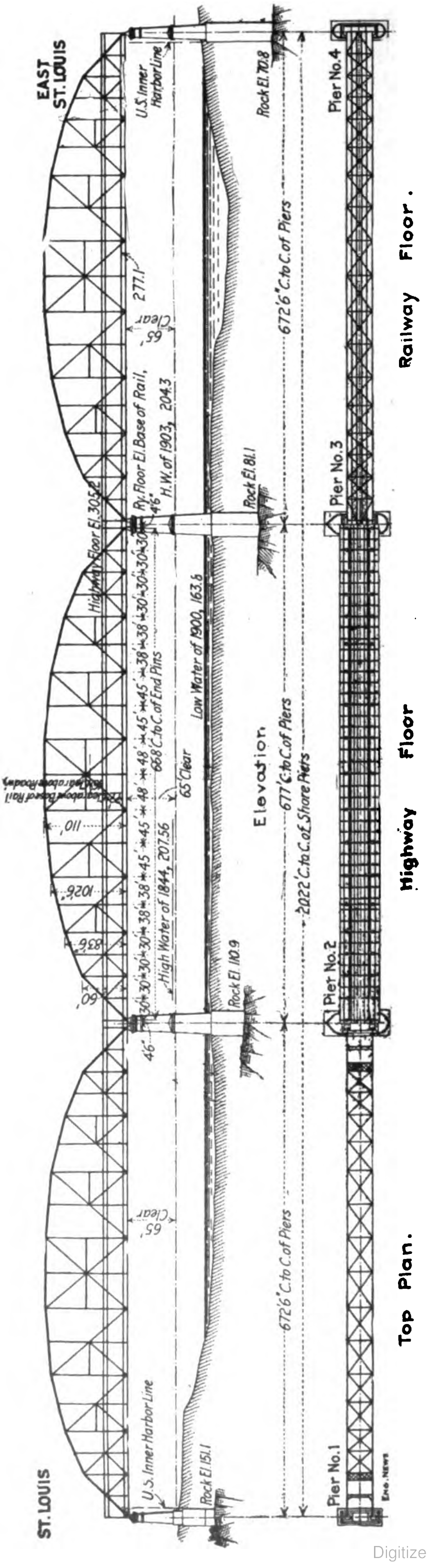


Fig. 1.—Elevation and Plan of the River Portion of the St. Louis Municipal Bridge.

The foundations for the river piers are to be carried to bed rock, which has a maximum depth of 92 feet below low water and a great head of water will probably have to be gone through as extreme low water is not probable at the time of landing this pier.

The piers are of concrete with Indiana limestone facing and granite cutwaters, copings and pedestals. Their general design is shown in Fig. 2 and Fig. 3.

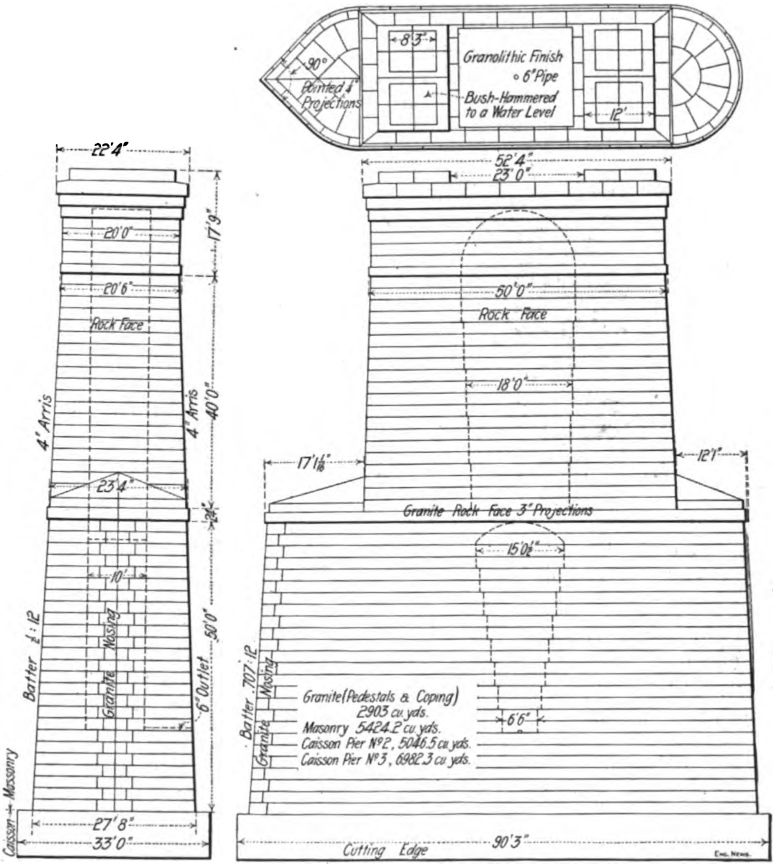


Fig. 2.—Channel Piers of the St. Louis Municipal Bridge.

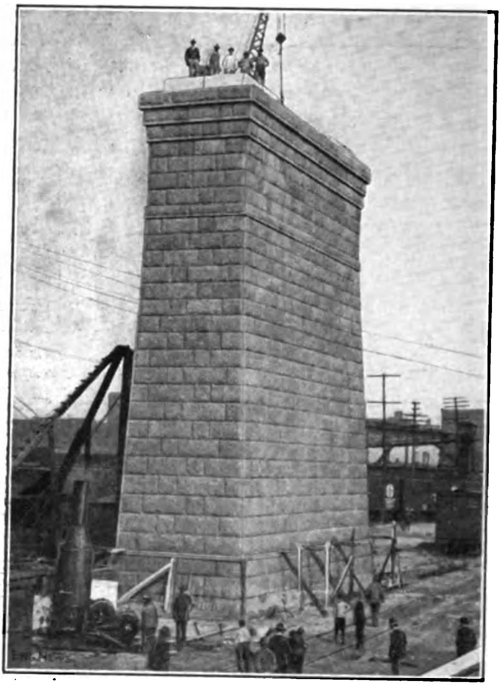


Fig. 3.—Pier No. 1, Shore Pier on the St. Louis Side.

The city ordinance for the construction of this bridge required that it should have two railroad tracks, two trolley tracks, a driveway, and two footways, and after considerable investigation it was determined to place the two railroad tracks on the lower deck of the river spans and two trolley tracks, roadway, and footways on the upper deck, but on the approaches the trolley tracks, roadway, and footways swing to one side of the railroad tracks and approach the ground with a steeper gradient than the railroad.

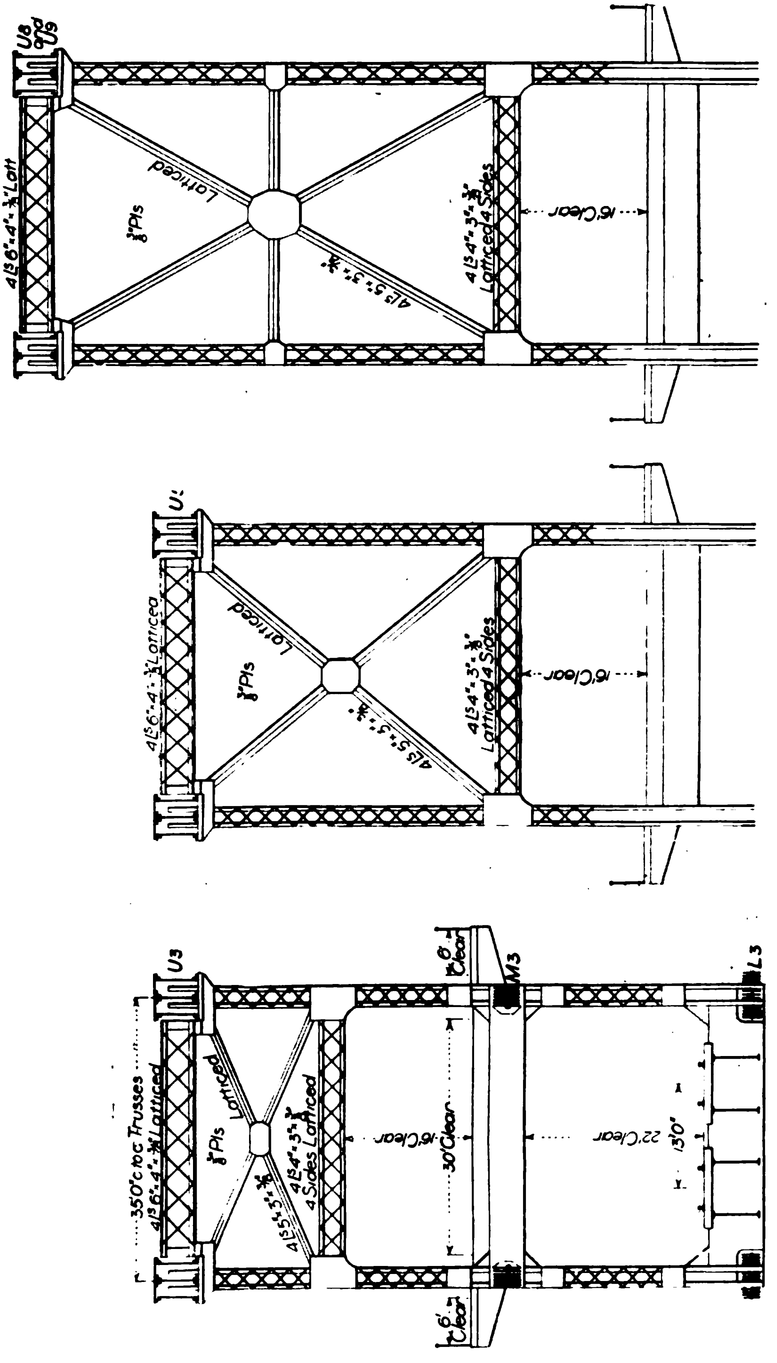


Fig. 4—Typical Cross Section.

The structure has been designed for very heavy loads on each line of travel, each railroad track having been designed for two locomotives with 60,000 on each driving axle, followed by a continuous train of 5,000 pounds per lineal foot. The roadway will be supported on reinforced concrete arches, supported on steel stringers, and on these arches will be a wood block pavement. Each trolley track is designed for two loaded trolley cars, each weighing 35 tons, or for a continuous load of 1400 pounds per lineal foot of each track. The roadway is designed for a local load of 100 pounds per square foot, or a continuous load of 75 pounds per square foot, or a roadway roller weighing 18 tons, and the sidewalks are designed for a local load of 100 pounds per square foot or for a continuous load of 60 pounds per square foot; each and all of these loads to be placed in such positions as to give the maximum stresses on each member.

Two complete designs were made for this structure, one having nickel steel eye bars; all other portions of the structure being of carbon steel, and the second design having nickel steel truss members throughout, with carbon steel floor and lateral systems. The unit stresses for carbon steel and nickel steel used in making these two designs are given on the following table:

ST. LOUIS BRIDGE.

Unit Stresses in Pounds Per Square Inch.

	Carbon Steel.		Nickel Steel.	
	Live.	Dead.	Live.	FRWDD
Flanges of Railway Stringers and Floor-beams,	10,000	10,000	....	....
Flanges of Highway Stringers and Floor-beams,	12,500	12,500	....	....
Wind Bracing, ...(Compression)	15,750-60$\frac{L}{R}$	15,750-60$\frac{L}{R}$	....	....
Wind Bracing, ...(Tension)	13,500	13,500	....	....
Power driven Rivets, ...(Shearing)	10,000	10,000	....	....
Hand driven Rivets, ...(Shearing)	8,000	8,000	....	....
Power driven Rivets, ...(Bearing)	16,000	16,000	....	....
Hand driven Rivets, ...(Bearing)	12,800	12,800	....	....
Rivets for Wind Bracing, ..(Shearing)	15,000	15,000	....	....
Rivets for Wind Bracing, ..(Bearing)	24,000	24,000	....	....
Vertical Sub-posts, ...	....	24,000-80$\frac{L}{R}$	....	....
Bottom Chords and Main Diagonals, (Eyebars)	....	....	16,000	32,000
Main Diagonals, ...(Riveted)	10,000	20,000	13,000	26,000
Long Verticals, ...	9,000	18,000	12,000	24,000
Outside fibres of Pins, ...	....	....	36,000	36,000
Power driven Rivets and Pins, (Shearing)	10,000	10,000	14,000	14,000
Hand driven Rivets, ...(Shearing)	8,000	8,000	11,200	11,200
Power driven Rivets, ...(Bearing)	16,000	16,000	22,000	22,000
Hand driven Rivets, ...(Bearing)	12,800	12,800	17,600	17,600
Pins, ... (Bearing)	18,000	18,000	24,000	24,000
Compression Members for $\frac{L}{R}$ equal 40 or under, ...	10,500	21,000	15,000	30,000
Compression Members (lengths over 40R), ...	12,000-40R	24,000-80R	17,000-55R	34000-110R
Inclined Sub-posts, ...	10.500-40R	21,000-80R	14,000-45R	28,000-90R

Bids were taken on both these designs, and it was found that the bid for nickel steel trusses was the most advantageous, so that this structure is now being constructed with nickel steel for all the truss members, except the sub-posts supporting the centres of the top chord panels.

The quality of material for both nickel and carbon steel is shown on the following table:

CARBON STEEL.

Shapes.	Specimen Tests. Pounds per Sq. Inch.			Percent Min.		Chemical Composition. Percent Maximum.				
	Ultimate Strength.		Elastic Limit,	Elongation in 8 Inches.	Reduction of Area.	Phos.		Sulph.		
	Min.	Max.	Min.			Acid.	Basic.	Acid.	Basic.	
Rivets,	52000	63000	30000	28	50	.04	.03	.04	.04	.60
Plates and shapes,	60000	70000	33000	25	40	.06	.04	.05	.05	.60
Rollers,	65000	75000	35000	22 in 2 in.	35	.06	.04	.05	.05	.60
Cast steel,	65000	75000	33000	20 in 2 in.	30	.08	.04	.05	.05	.80

NICKEL STEEL.

Shapes.	Specimen Tests. Pounds per Sq. Inch.			Percent Min.		Chemical Composition. Percent Maximum.						
	Ultimate Strength.		Elastic Limit,	Elongation in 8 Inches.	Reduction of Area.	Phos.		Sulph.				
	Min.	Max.	Min.			Acid.	Basic.	Acid.	Basic.			
Rivets,	70000	80000	45000	22	40	.06	.04	.04	.04	.70	.45	3.25
Plates and shapes,	85000	100000	50000	16	25	.04	.03	.03	.03	.60	.30	3.25
Bars, annealed,	90000	105000	52000	20	35	.06	.04	.04	.04	.70	.45	3.25
Pins & bars, unannealed	95000	110000	55000	16 in 2 in. for Pins.	25	.06	.04	.04	.04	.70	.45	3.25
	Full Size Tests.											
Annealed bars,	85000	100000	48000	10 in 18 ft.	35							

The specifications for workmanship are practically those in general use for first class bridge material requiring all material to be sub-punched and reamed, or drilled from the solid.

The river crossing consists of three spans, each 667 feet center to center of end pins, and it will be noted that these spans are made with varying lengths of panels, the end panels being 30 feet, and the center panels 48 feet. This was found to be more economical than a constant length of panel, and it also made a more pleasing outline for the trusses as the inclination of the diagonals is nearly constant. The trusses are 60 feet deep at the end and 110 feet deep in the center, and the width center to center of trusses is 35 feet.

The railway floor system is similar to the usual practice but the highway floor system is arranged with two longitudinal stringers adjacent to the main trusses, these stringers being supported by floorbeams at the panel points and in turn supporting sub-floorbeams, on which the longitudinal rolled beam stringers rest.

This arrangement was found to save a very considerable amount of metal and it divides the main panels so that all stringers are practically of the same span, not exceeding 16 feet in length.

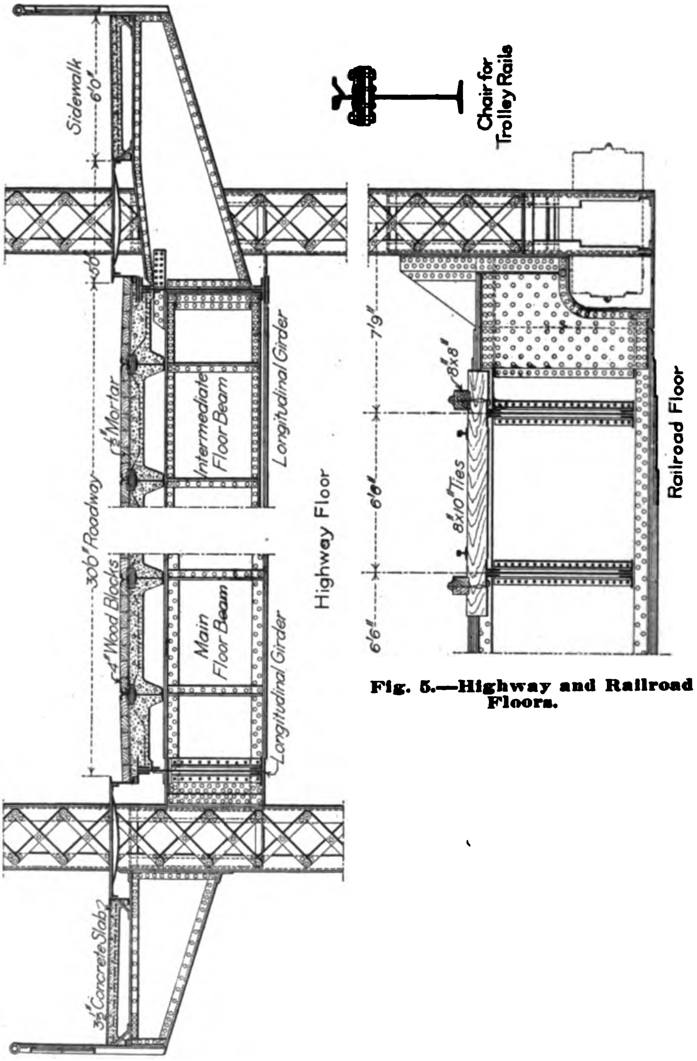


Fig. 5.—Highway and Railroad Floors.

In some respects the design of the members of this structure varies from previous practice. One of the main variations being in the arrangement of the end post and top chord sections, which are made with three vertical webs, with horizontal webs connecting the vertical webs along their central axis, and with channel latticing on the top and bottom of vertical webs.

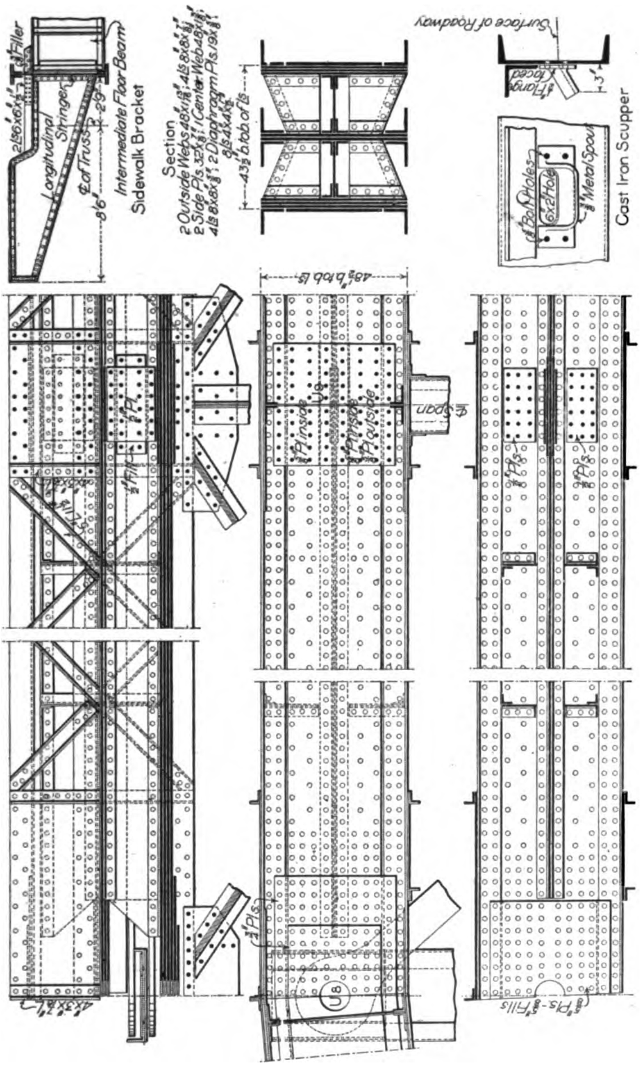
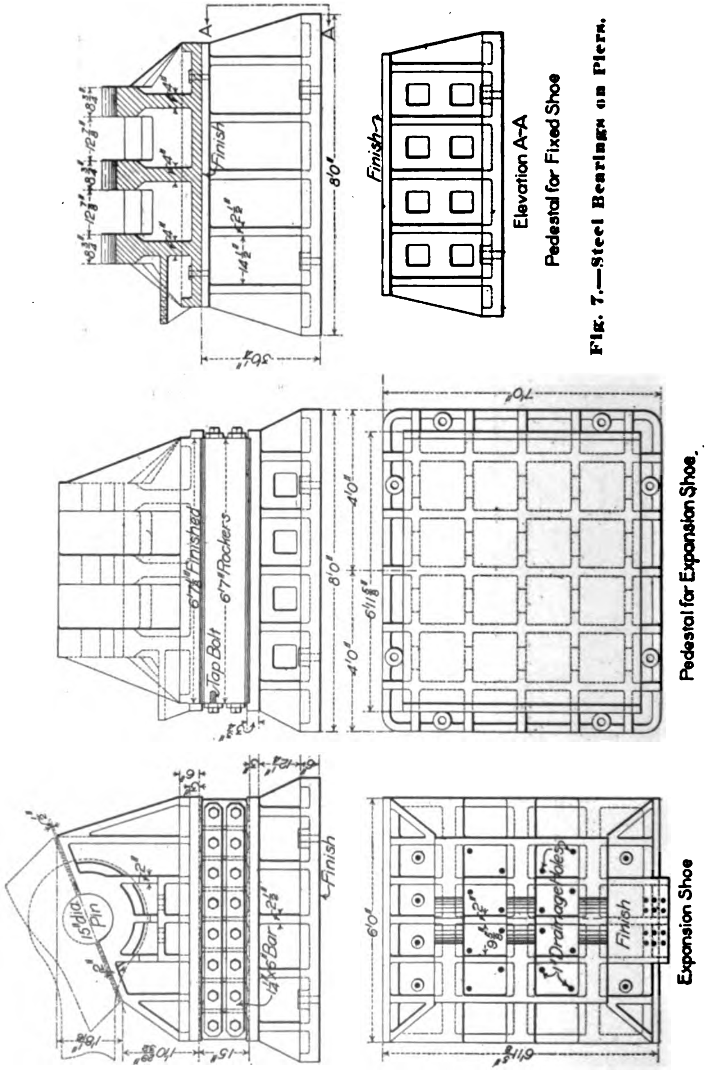


Fig. 6.—Top Chord and Details of Sidewalk and of Curb Girder.

The area of the horizontal webs is considered to be a portion of the main section of these chord members, and where these horizontal webs are cut away at the ends of the pins, additional section is placed on the vertical webs by means of thickening plates. These top chords have faced bearings at all joints, except at the top and bottom of the inclined end posts, but in making these faced bearings, the area of the ends is increased by thickening plates on the vertical webs, so that the area of the faced bearings is equal to the area of the main cross section of the member without considering the diameter of the pin hole or the outstanding legs of any of the angles forming the flanges on the vertical webs, The span is supported on shoes of cast steel, and it was found extremely difficult to make a satisfactory connection of the lower lateral diagonals to these end shoes, so that such a connection was abandoned and the lower lateral system is connected to the center of the bottom flange of the end floor beam, this flange being properly increased to carry this additional stress.



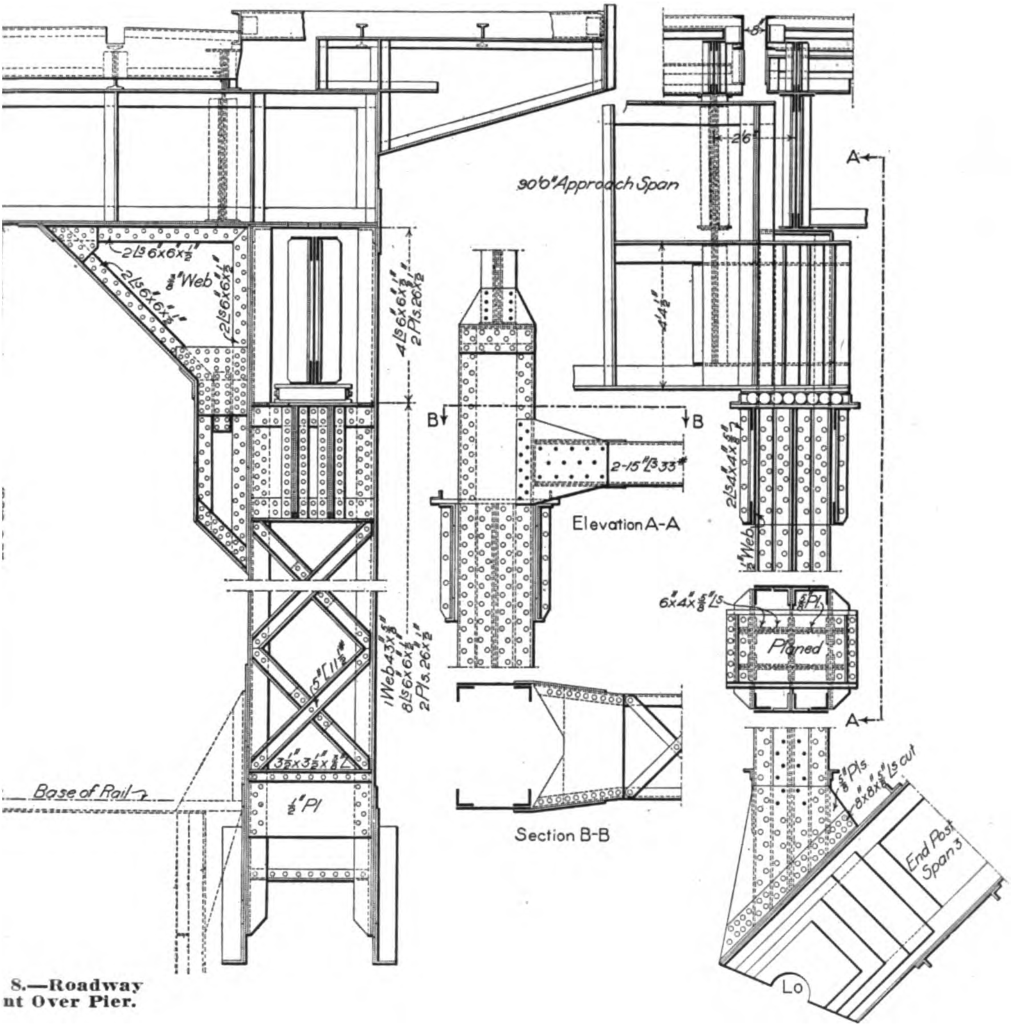
Pedestal for Fixed Shoe

Pedestal for Expansion Shoe

Expansion Shoe

Fig. 7.—Steel Bearings on Piers.

The dead load stresses in this structure were roughly computed with a uniform dead load, and after the sections had been arrived at, the actual dead load at each panel point was figured up and the dead load stresses were again computed, using these actual panel



8.—Roadway
nt Over Pier.

concentrations, so that the dead loads as shown on the stress sheet are figured from the actual panel concentrations as given on the diagram, but it will be noticed that these concentrations prove that the dead load for a structure of this character is practically uniform for its entire length. See inset.

The stresses in the floor beams and stringers have been tabulated as follows:

RAILROAD FLOOR BEAMS.

END FLOOR BEAM F0.

Bending	Shear
C. 1,668,300	L. 198,760
Wt. 40,600	D. 22,200
1,708,900	220,960

1,708,900÷6.82=250,600 Chord Stress
1 Web 86″ x $\frac{7}{16}$″=37.65°″
2 Ls 8″ x 8″ x ⅞″=26.46—3.72=22.74
1 Cov. 17″ x ½″=8.5—1.12 = 7.38 (17′ lg.)
30.12°″ Net

FLOOR BEAMS F1—F2—F3.

Bending	Shear
C. 2,878,000	L. 259,000
Wt. 65,300	D. 35,900
2,937,300	294,900

2,937,300+7.1=413,700 Chord Stress
1 Web 86″ x ½″=43.0°″
2 Ls 8″ x 8″ x ⅞″=26.46—3.72=22.74
1 Cov. 17″ x ⅝″=10.62—1.33 = 9.29 (25′ lg.)
1 Cov. 17″ x ⅝″=10.62—1.33 = 9.29 (18½′ lg.)
41.32°″ Net

FLOOR BEAMS F4—F5.

Bending	Shear
C. 3,498,000	L. 310,800
Wt. 81,700	D. 48,900
3,579,700	359,700

3,579,700÷7.1=504,000 Chord Stress
I Web 86″ x $\frac{9}{16}$″=48,375°″
2 Ls 8″ x 8″ x ⅞″=26.46—3.72=22.74
1 Cov. 17″ x ⅝″=16.60—1.33 = 9.29 (26½′ lg.)
1 Cov. 17″ x ⅝″=10.62—1.33 = 9.29 (22½′ lg.)
1 Cov. 17″ x ⅝″=10.62—1.33 = 9.29 (16½′ lg.)
50.61°″ Net

FLOORBEAMS F6-F7.

Bending	Shear
C. 4,048,000	L. 355,800
Wt. 95,300	D. 60,600
4,143,300	416,400

4,143,300÷7.2=575,500=Chord Stress.
1 Web 86″ x ⅝″=53.75°″
2 Ls 8″ x 8″ x $\frac{7}{16}$″=26.46—3.72=22.74
1 Cov. 17″ x $\frac{11}{16}$″=11.69—1.46 =10.23 (27½′ lg.)
1 Cov. 17″ x $\frac{9}{16}$″= 9.56—1.19 = 8.37 (24 ′ lg.)
1 Cov. 17″ x $\frac{9}{16}$″= 9.56—1.19= 8.37 (20½′ lg.)
1 Cov. 17″ x $\frac{9}{16}$″= 9.56—1.19= 8.37 (14½′ lg.)
58.02°″ Net.

Floorbeams F8-F9.

Bending	Shear
C. 4,272,000	L. 374,400
Wt. 98,000	D. 64,700
4,370,000	439,100

4,370,000÷7.2=607,000″ Chord Stress
1 Web 86″ x ⅝″=53.75°″
2 Ls. 8″ x 8″ x ⅞″=26.46—3.72—22.74
1 Cov. 17″ x $\frac{11}{16}$″=11.69—1.46 =10.23 (27½′ lg.)
1 Cov. 17″ x ⅝″=10.52—1.33 = 9.29 (24 ′ lg.)
1 Cov. 17″ x ⅝″=10.52—1.33 = 9.29 (21 ′ lg.)
1 Cov. 17″ x ⅝″=10.52—1.33 = 9.29 (15 ′ lg.)
60.84

60.84°″ Net.

Stringers Between Spans—9 Ft. Long.

Bending	Shear
L. 70,350	L. 43,350
D. 3,050	D. 1,350
73,400	44,700

73,400÷2.2=33,360 lbs. Chord Stress
1 Web 28″ x $\frac{7}{16}$″=12.25°″ Net
2 Ls. 6″ x 4″ x $\frac{7}{16}$″=8.3—0.9=7.4°″ Net

RAILROAD STRINGERS

30 Ft. Stringers

Bending	Shear
L. 615,800	L. 94,500
D. 52,200	D. 7,000
668,000	101,500

668,000÷5.75=116,200 lbs. Chord Stress
1 Web 77″ x $\frac{7}{16}$″=31.5°″
2 Ls. 6″ x 6″ x ⅝″=14.22—2.5=11.72°″ Net

Bending	Shear
L. 900,000	L. 109,700
D. 90,300	D. 9,500
990,300	119,200

990,300÷5.8=170,900 lbs. Chord Stress
1 Web 77″ x $\frac{7}{16}$″=31.5°″
2 Ls. 6″ x 6″ x ⅝″=14.22—2.5 =11.72°″
1 Cov. 13″ x ½″=6.5—10 = 5.5 (24′ lg.)

17.22°′ Net

45 Ft. Stringers

Bending	Shear
L. 1,200,900	L. 122,550
D. 126,600	D. 11,250
1,327,500	133,800

1,327,500÷6.0=221,250 lbs. Chord Stress
1 Web 77″ x $\frac{7}{16}$″=31.5°″
2 Ls. 6″ x 6″ x ⅝″=14.22—2.5 =11.72
1 Cov. 13″ x ½″=6.5—1.0 = 5.5 (33′ lg.)
1 Cov. 13″ x ½″=6.5—1.0 = 5.5 (24′ lg.)

22.72°″ Net

48 FT. STRINGERS

Bending	Shear
L. 1,331,400	L. 127,200
D. 156,600	D. 13,000
1,488,000	140,200

1,488,000÷6.0=248,000 lbs. Chord Stress
1 Web 77" x 7/16"=31.5°"
2 Ls. 6" x 6" x ⅝"=14.22—2.5 =11.72
1 Cov. 13" x ⅝"=8.12—1.25 = 6.87 (37′ lg.)
1 Cov. 13" x 9/16"=7.31—7.12 = 6.19 (26′ lg.)
24.78°" Net

HIGHWAY FLOOR SYSTEM

INT. FLORBEAM 1HF

Bending=513,100 Shear=77,400
513,100÷3.8=135,000 lbs. Chord Stress
1 Web 47" x ⅜"=17.5°"
2 Ls. 6" x 4" x ⅝" =11.72—1.25=10.47°" Net

MAIN FLOORBEAMS HF8-9

Bending=1,018,200 Shear=266,400
1,018,200÷3.9=261,000 lbs. Chord Stress
1 Web 48" x ⅜"=18°"
2 Ls. 6" x 6" x ⅝"=14.2—2.5 =11.7
1 Cov. 13" x 13/16"=10.56—1.62 = 8.94 (29′ lg.)
20.64°" Net

END FLOORBEAM HF0

Bending=748,700 Shear=120,900
748,700÷3.85=194,500 lbs. Chord Stress
1 Web 48" x ⅜"=18°"
2 Ls. 6" x 6" x ¾"=16.88—1.5=15.38°" Net

SIDEWALK BRACKET 1B

Bending=140,650 Shear=16,200
140,650÷3.25=43,270 lbs. Chord Stress
1 Web 52" to 18" x ⅜"
2 Ls. 3½" x 3" x ⅜"=4.6—0.6=4.0°" Net

MAIN FLOORBEAMS HF1-2-3

Bending=813,400 Shear=162,400
813,400÷3.9=208,700 lbs. Chord Stress
1 Web 48" x ⅜"=18°"
2 Ls. 6" x 6" x ⅝"=14.2—2.5 =11.7°" Net
1 Cov. 13" x ½"=6.5—1.0 = 5.5 (25′ lg.)
17.2°" Net

30 FT. LONG'L GIRDER

Bending=723,700 Shear=49,900
723,700÷5.0=144,700 lbs. Chord Stress
1 Web 61½" x ⅜"=23.0°"
2 Ls. 6" x 6" x 9/16"=12.86—1.13=11.73°" Net

MAIN FLOORBEAM HF4

Bending=850,800 Shear=182,600
850,300÷3.9=218,000 lbs. Chord Stress
1 Web 48″ x ⅜″=18°″
2 Ls. 6″ x 6″ x ⅝″=14.2—2.5 =11.7
1 Cov. 13″ x ½″=6.5—1.0 = 5.5 (25′ lg.)

17.2°″ Net

38 FT. LONG'L GIRDER

Bending=1,170,800 Shear=114,900
1,170,800÷5.1=229,600 lbs. Chord Stress
1 Web 61½″ x ⅜″=23.0°″
2 Ls. 6″ x 6″ x ⅝″=14.2—2.5 =11.7
1 Cov. 13″ x ⅝″=8.12—1.2 = 6.9 (24′ lg.)

18.6°″ Net

MAIN FLOORBEAM HF5

Bending=410,900 Shear=221,800
410,900÷3.85=106 lbs. Chord Stress
1 Web 48″ x ⅜″=18°″
2 Ls. 6″ x 6″ x $\frac{7}{16}$″=10.0—1.75=8.25°″ Net

45 FT. LONG'L GIRDER

Bending=1,443,900 Shear=98,000
1,443,900÷5.1=283,100 lbs. Chord Stress
1 Web 61½″ x ⅜″=23.0°″
2 Ls. 6″ x 6″ x ¾″=16.88—3.0 =15.88
1 Cov. 13″ x $\frac{13}{16}$″=10.56—1.62 = 8.94 (29′ lg.)

22.82°″ Net

MAIN FLOORBEAMS HF6-7

Bending=956,200 Shear=248,400
966,200÷3.9=247.800 lbs. Chord Stress
1 Web 48″ x ⅜″=18°″
2 Ls. 6″ x 6″ x ⅜″=-4.2—2.5 =11.7
1 Cov. 13″ x ¾″=9.75—1.5 = 8.25 (27′ lg.)

19.95°″ Net

15 FT. STRINGERS

Bending=62,660
15″ I 45 lbs. per ft. S=60.8

16 FT. STRINGERS

Bending=69,320
15″ I 55 lbs. per ft. S=68.1

48 FT. LONG'L GIRDER

Bending=1,622,400 Shear=103,200
1,622,400÷5.1=318,000 lbs. Chord Stress
1 Web 61½″ x ⅜″=23.0°″
2 Ls. 6″ x 6″ x ¾″=16.88°″—3.0 =13.88
1 Cov. 13″ x $\frac{9}{16}$″=7.31—1.13 = 6.18 (33′ lg.)
1 Cov. 13″ x ½″=6.5—1.0 = 5.50 (25′ lg.)

25.56°″ Net

Figures 8 and 9 show some further details of this structure, and require no description, as they, with the few exceptions noted above follow the usual practice in long span bridges of this character.

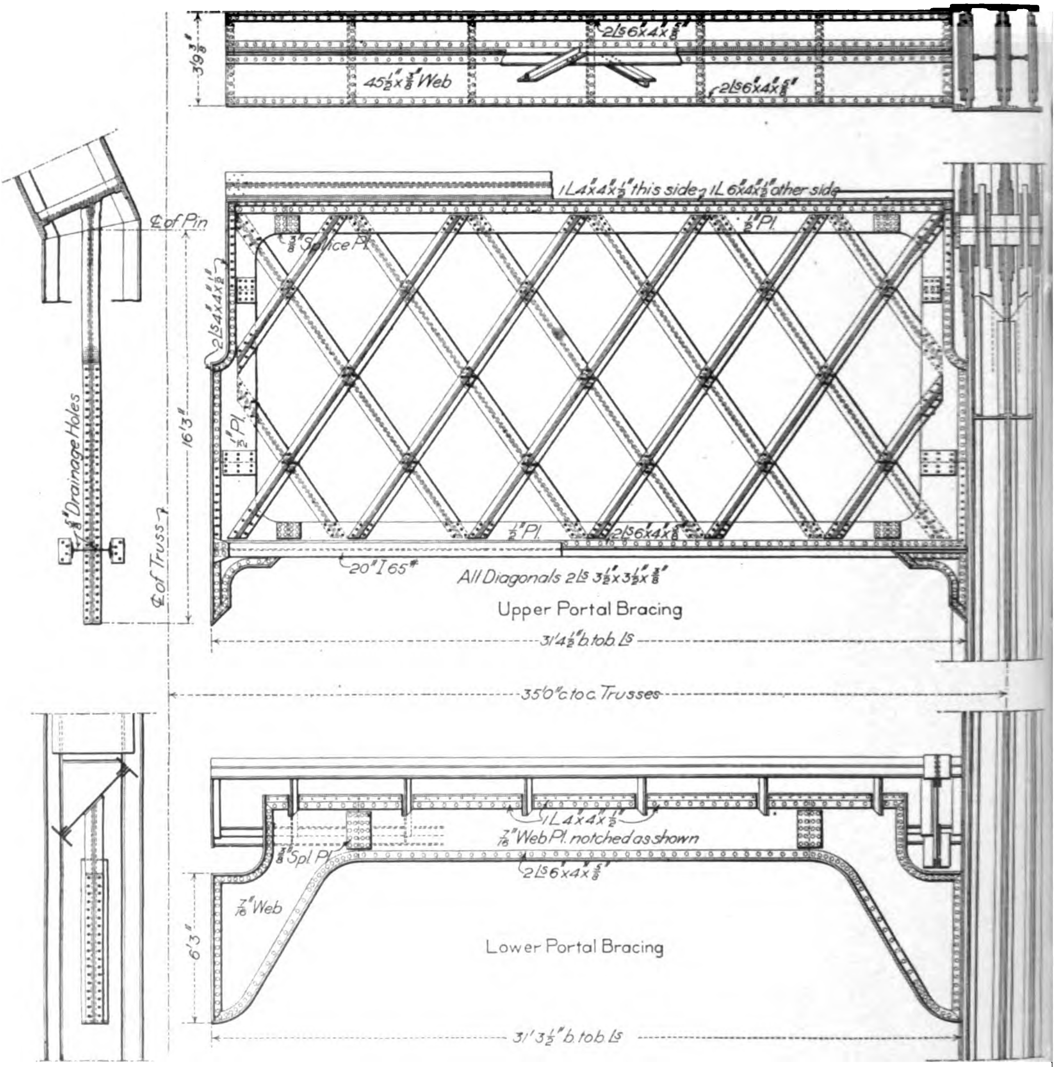


Fig. 9.—Portal Construction.

The weight of these three river spans is 27,600,000 pounds divided as follows:

Pedestals and shoes, ...	510,000	pounds.
Pins and rivets, ...	477,000	"
Rollers, ...	126,000	"
Railway floor system, ...	3,791,000	"
Highway floor system, ...	4,107,000	"
Laterals and traverse bracing,	1,067,000	"
Trusses		
Eye bars, ...	6,753,000	"
Built members, ...	10,769,000	"
	27,600,000	pounds.

In addition to these river spans there will be long approaches in both St. Louis and East St. Louis for both railway and highway connections, and the total length of this structure from end to end will be in the neighborhood of two miles.

The entire structure is being built by the Board of Public Improvements of the City of St. Louis, under the Hon. Maxime Reber, President, and the structure was designed and is under the superintendance of Messrs. Boller & Hodge, Construction Engineers. The contract for the substructure is being carried out by the Missouri Valley Bridge and Iron Company, and the superstructure of the river spans is being constructed by the American Bridge Company. Contracts for the approaches have not yet been let.

The approximate cost of the bridge is estimated at $3,500,000, the foundations for the river spans costing $460,000, and the steel superstructure for the river spans $1,600,000.

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ECONOMICS IN THE PRODUCTION OF POWER

By EDWARD T. CHILD.

Read before the Society, May 4, 1909.

THE POWER PLANT OF THE SOUTHWARK FOUNDRY AND MACHINE COMPANY.

The Southwark Foundry and Machine Company was founded in 1836, but was arranged in its present general form in 1881, at which time an 11½" x 20" Porter-Allen engine was installed, driving the various shops by line shafts and belts, including several quarter-turns, the transmission reaching from one end of the block to the other. The foundry cranes and electric generators were driven by two other Porter-Allen engines, each 11" x 16".

Since 1907 this has been changed to an electrically-driven plant. All of the long lines of shafting, and all of the quarter-turns, have been cut out. On the larger tools, independent variable speed motors are used. The smaller tools are still driven by belts, one motor driving a number of machines. All new tools purchased for several years however, are provided with individual motor drives, and the object is eventually to discard all shafting.

In changing to electrical drive, we did not expect to save any power; in spite of the evident saving in friction of shafting. The experience of our friends, Wm. Sellers & Co., Inc., had been that the driving of machine tools by motors saved no power, and a little consideration shows why this may easily be so.

The motor on a machine tool must be able to do the hardest work that the machine ever has to do, but in a shop where there is a variety of work it is frequently impossible to use this power in the tool, and so most of the time the motor is running underloaded and with poor efficiency.

Moreover, under the old method, the speed of the shafting was frequently below the normal for short periods, due to overloads, thus saving power at the expense of output. Under the new method, the speed is not only kept constant, but in most instances has been increased from 5% to 15%.

In the case of individual drives, the ease of manipulation results in a considerable average increase in the speed of the tools. The result of these increases in speeds is of course a considerable increase in the power required, with a corresponding increase in output of work.

As the thing has worked out, we find that it takes more power to drive our shops electrically than it did to drive them by belts and shafting. The maximum I. H. P. used before the change was about 365, and after the change it was about 425, an increase of 60 I. H. P. Of this increase fully 40 I. H. P. was spent on increased electric lighting, so that the tools including the cranes, used only about 20 I. H. P. more than they did under the old method. We had estimated that the increase in power would be 72 I. H. P., so that we were very well pleased with the result.

Our new power plant is arranged on the following lines:

Boilers.

We have three water-tube boilers: One Edgemoor of 300 H. P. and two Keeler of 200 H. P. each. The steam pressure is 150.

The Smith Shop hammers are supplied through a reducing valve which cuts the pressure down to 90 pounds, and a waste heat boiler in the Smith Shop also feeds into the 90 pound header.

The boilers are fired by hand with rice or buckwheat coal, which is dropped from cars into a track hopper, and is then taken by a conveyor to a storage bin, after which it runs onto the floor of the Boiler House as needed. The ashes are wheeled away by hand, as we have not yet found a more economical way of handling such a small quantity of ashes.

The city of Philadelphia has at various times passed smoke ordinances, which may or may not be constitutional. But at any rate we desire to make no smoke if we can avoid it.

The only way that we have found to prevent all smoke, is to burn anthracite coal. To do this economically, it is of course necessary to use the smaller sizes, and consequently to use forced draft under the boilers.

We have installed the system of "Balanced Draft" of the Engineer Company, of New York. The idea is to have neither pressure nor vacuum in the fire box, but exactly the pressure of the atmosphere. There will then be no tendency for air to leak in through openings in the boiler settings, and no inrush of air to cool off the boiler when the fire door is opened.

A fan is used to blow air into the ash-pit with enough pressure to force it through the fuel; and the chimney damper is kept open just enough to carry away the products of combustion, without creating a vacuum over the fire.

Of course, these ideal results are not fully obtained, but the

Balanced Draft System comes near enough to obtaining them to be very satisfactory. It has worked well and given no trouble.

It enables us to burn any kind of coal that we can get; and when bituminous coal is used, it enables us to force our boilers to nearly double their rating. But in this case a great deal of smoke is produced.

Our fan has an engine on each end of the shaft. They run on alternate weeks. This is an important point, as our plant frequently has to run day and night continuously, and it is necessary to be able to shut these engines down, to keep them in good order.

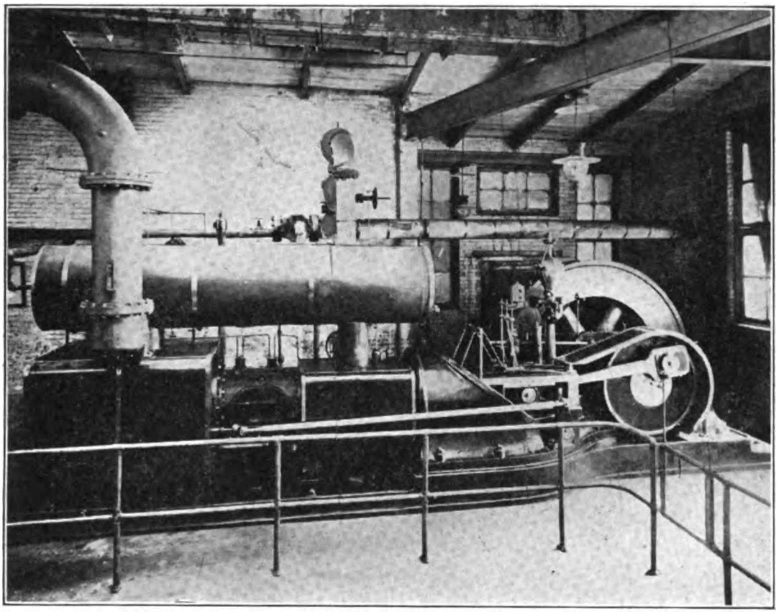


Fig. 1.

The Balanced Draft System was guaranteed to make a large saving in the cost of fuel. We have not found any saving. But we have found the system convenient, and with it we obtain complete freedom from smoke when burning anthracite coal, or a mixture of three parts anthracite and one part bituminous coal; and comparatively little smoke when burning bituminous coal, if we do not try to force the boilers.

Below are the results of the tests made at the time the Balanced Draft System was installed at our works:

Kind of coal, ...	Soft coal.	Buckwheat.	Rice.
Brand of Coal, ...	Miller Vein.	Pond Creek.	Lattimer.
Cost of coal per ton, .	\$2.50	\$2.25	\$1.75
Comparative cost, ...	1.00	1.03	0.95
Balanced Draft, ...	Not in use.	In use.	In use.

Engine.

Our power is generated by the tandem compound Porter-Allen Engine shown in Fig. 1. The steam cylinders are 14½" and 32" in diameter by 24" stroke.

Between the cylinders is a reheating receiver filled with steel tubes, having 400 square feet of heating surface, this being sufficient to superheat the steam entering the low-pressure cylinder from 50° to 80° F.

We have made a careful investigation of the reheater question, and find that when an engine is equipped with a *large* reheater, there is a saving in total steam consumption of from 4% to 8%. The saving seems to come from the decrease in initial condensation in the low pressure cylinder, due to the steam entering it being superheated. In addition, the lubrication in the low pressure cylinder is better, since wet steam washes away the oil.

But we have found that a reheater with only a small amount of heating surface is worse than useless for increasing economy. The steam must enter the low pressure cylinder superheated, or there will be no gain in economy.

Our engine runs 200 r. p. m. and drives a 220-volt direct current Crocker-Wheeler generator of 300 K. W. capacity, good for 100% overload for a few minutes.

The engine is designed for 200 r. p. m. and does not impress one as running fast—scarcely as much, for instance, as a Corliss Engine running 100 or 125 r. p. m. We expect this engine to be just as good for hard service twenty-five years from now as it is to-day.

Condensing Plant.

To condense the steam from this engine we use a Weiss Condenser and Cooling Tower, shown in Fig. 2. The cooling tower is 12 feet square and 39 feet high, with extensions on the sides making it 24 feet by 12 feet at the bottom. The water flows over baffle boards in these side extensions, the sole function of the tower proper being that of a chimney—to create a draft.

There are no fans used. The vacuum is 27" to 28" in the winter, and 24" to 25" in the summer. The cooling water is about 80° F. in the winter, and from 110° to 115° F. in the summer.

It will be noted that the tower covers 288 sq. ft., or say one sq. ft. per Kilowatt, or two-thirds of a square foot per indicated horse power. Of these two-thirds, one-third of a square foot is used to distribute the water, and one-third of a square foot for the chimney alone. If the chimney were placed above the water racks instead of beside them, we would doubtless get just as good an effect, or, in other words we could probably do with one-third of a square foot of ground area per horse power if the tower were fifty to sixty feet high.

The water is pumped by a motor driven centrifugal pump. The cooling tower is on the roof of the engine room, high enough for the condenser to draw its water in without pumping.

No cooling water has to be added from outside sources, as the evaporation from the tower is considerably less than the amount of exhaust steam that is added.

The water condenses the steam, goes to the tower and is cooled off, and is ready to condense the steam again in about two minutes—in other words, the system contains about two minutes' supply of water.

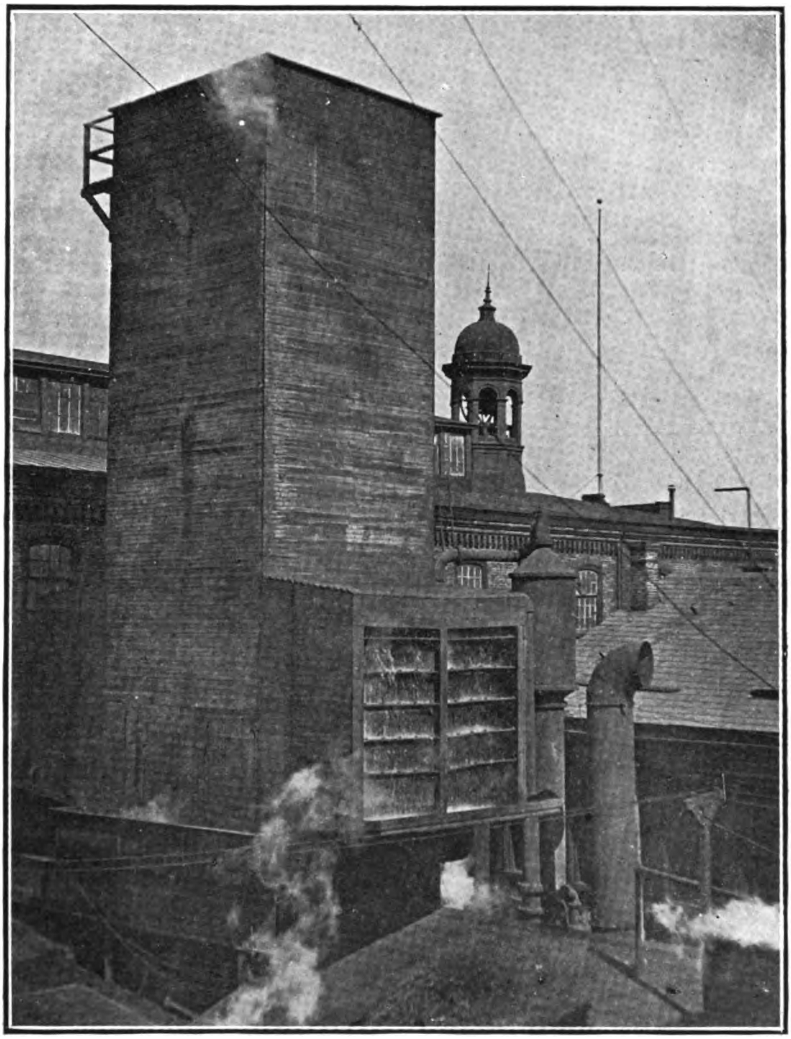


Fig. 2.

We have for driving our dry vacuum pump, an old Porter-Allen Engine that drove our shops for twenty-six years. Driving the shops it ran 305 r. p. m. It now runs about 60 r. p. m., and ought to be good for a long period of service.

Of course, cooling water of 115° F. is very hot. We could get cooler water by using a larger and more expensive tower, or by using fans to force the air in; but the expense of doing these things would be considerable, and they are unnecessary in a plant using a Weiss condenser. It is probable that no other condenser could be used with such hot cooling water. At any rate, the author has had a large experience with condensers, and has never seen any other condenser working with such hot water.

The reasons that the Weiss Condenser can do this, are as follows:

It was formerly considered that the condenser problem was to reduce the pressure of the air in the condenser to the lowest point. The vapor pressure cannot be reduced, for it is the same in the poorest condenser as in the best, being dependent solely on the temperature, which in turn depends solely on the relative amounts of steam and water used and on their temperatures. The back pressure on the engine used to be the sum of the pressures of the air and of the vapor, and by using large air pumps the air pressure was kept as low as possible.

Mr. F. J. Weiss, of Basel, in Switzerland, conceived the idea of a condenser in which air and the vapor should be kept apart, not by partitions, for that was impossible, but by creating currents which carried the air to the cold top of the condenser and away from the hot water. He called this the "counter current" principle. The water vapor goes with the air. That cannot be prevented. But it does not matter. The lower part of the condenser at B, Fig. 3, is hot, and here there is no air, only water vapor; so here the pressure is only that which corresponds to the temperature of the water. If the temperature at B is 133° F., the pressure is 5 inches of mercury. The pressure at A must of course be the same as at B, for they are in communication. And at A there is

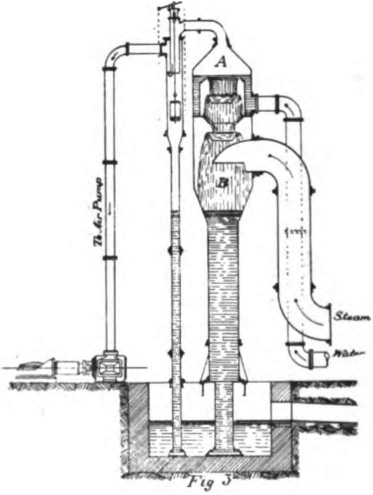


Fig. 3.

also water vapor pressure. But the temperature at A is low, and consequently the water vapor is cold and exerts almost no pressure, say two inches if the temperature is 100° F. Consequently it is only necessary to have an air pump large enough to reduce the air pressure to 3 inches of mercury, in order to get just as good a result in the engine as could be obtained by an infinitely large air pump, drawing air from B. The infinitely large pump would reduce the air pressure at B to zero. The air pressure, reduced to three inches at A, is practically zero at B, owing to the current. This famous "counter current" principle has revolutionized steam condenser building.

But the system cannot be used to its full advantage without leaving the condenser in a condition of very unstable equilibrium. The condenser runs at what is called the "critical point," economical and efficient to the utmost, but liable to "boil" and lose its vacuum at the least overload.

Many of the modern condensers can be run thus economically at the "critical point," but there is always the grave danger of "boiling" and losing the vacuum. The Weiss condenser boils, too, and is then in the condition shown in Fig. 4. There is, practically, a small parallel current jet-condenser attached to the side of the main condenser to cover just this contingency. When this auxiliary condenser works, the water going through it, by an automatic device, reduces the effect of the air pump, temporarily lowers the vacuum, and restores the condenser to its proper action. Without such device the boiling would result in complete loss of vacuum. With the device, the boiling of the condenser is usually not even noticed.

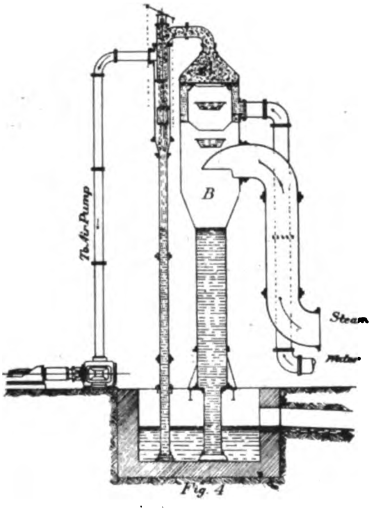


Fig. 4.

Distribution of Power.

The works of the Southwark Foundry & Machine Co. are compact, so that without greatly increasing the expense for copper wire, we have been able to separate our distribution lines into three classes. One class carries lights only, with a practically steady load. A second class carries cranes only, with an enormously fluctuating load. A third class carries the motors for driving tools. In this way we keep the cranes from interfering either with the lights or with the speed of the tools.

Lighting.

In our foundry we use flaming arc lamps, as they seem to penetrate the smoke better than any others. But the cost of trimming these lamps is high. In the less smoky parts of the foundry, and in the machine shop we use Cooper-Hewitt Mercury Vapor lamps. They are by far the most economical lamps to use, consuming little current and requiring practically no attention. We use the large self-lighting type of Mercury Vapor lamps, and have them wired on a special system of our own invention so that they will work properly with two 110 volt lamps in series on a 220 volt circuit.

Coal Consumption.

The compound condensing plant reduced our coal bill from $15,000 a year for the simple non-condensing engine, to $9,000; a saving of 40%, for producing approximately the same number of horse power hours. The above figures include all of the coal used for making steam.

When Does it Pay to Introduce Refinements in Steam Machinery?

It is of course a well known fact that when engines carry a steady load, it pays to build them compound and to equip them with a condenser. The usual rough idea is that each of these refinements results in a saving of about 20%. George H. Barrus in his book on "Engine Tests" is inclined to give the compound engine a greater saving than 20%—in fact, 25% to 28%, while he points out that the excessive cost of running the auxiliary machinery of many condensers reduces the saving due to their use to a comparatively small amount, say 11% to 15%. The moral of this is, not to condemn the principle of condensation, but to be sure to use an economical condenser.

So much for steady loads. What about variable loads? The load at the Southwark Foundry's plant, above described, was quite variable, yet the savings were most satisfactory. I propose to show that from the point of view of theory, the use of a condenser ought to pay better with a variable load than with a steady one, while the use of a compound engine ought to pay, although the theoretical amount of the saving cannot be exactly computed. And I propose to show also from a review of actual tests, that both of these savings, indicated by theory, are obtained in practice.

Then, since the saving due to the condenser may be greatly reduced by the choice of inferior condensing machinery, I propose to show what constitutes a good condenser; and finally I shall describe a simple way of making engine tests, so that anyone may easily determine how well or how badly his plant is being run.

Theoretical Saving Due to Condensation.

Fig. 5 shows the way in which the theoretical mean effective pressure in an engine varies with the cut-off. The curve is computed for 5% of clearance, otherwise, of course, when the cut-off was zero the mean effective pressure would also be zero.

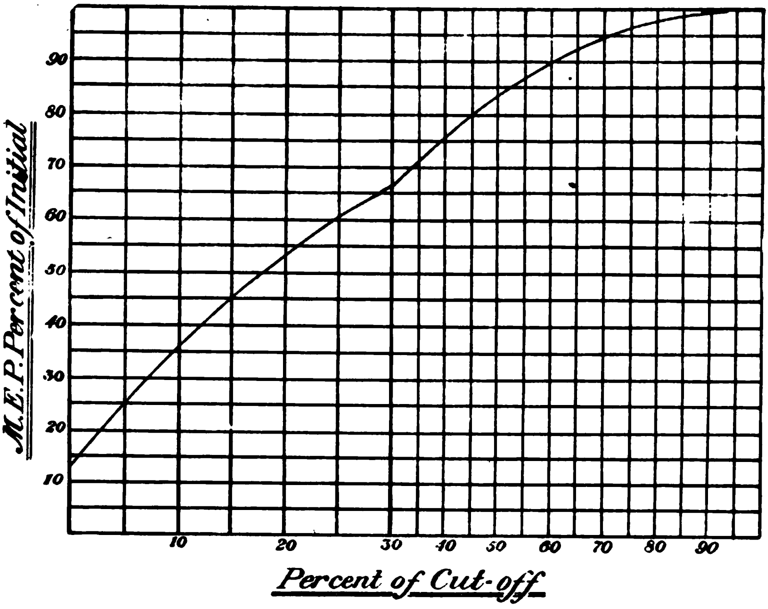


Fig. 5.

Consider a simple engine running on 100 lbs. steam pressure, and assume that the addition of a condenser will give 12 pounds additional mean effective pressure, or say 10% of the absolute initial pressure of 115 pounds.

Suppose the engine cuts off at 30%. Start where the curve cuts the 30% vertical, and come down ten of the smallest divisions, which brings the curve to the 22% vertical. So the cut-off will be diminished from 30% to 22%, by the use of a condenser. We will assume that of the 5% clearance, 3% is filled by the compression, and 2% must be filled from the boiler. There is a saving of 8 parts out of 32; or 25%.

If, however, the engine cuts off at 80%, the condenser, as will be seen by the curve, will reduce the cut off to 56%, a saving of 24 parts in 82; or 29%. If the original cut-off is 10%, the condenser will bring it down to 5%, a saving of 5 parts in 12, or 42%.

These figures neglect the very important effect of initial condensation, which will undoubtedly make the saving in every case less than the computed saving. The initial condensation will perhaps reduce the 42% in the light load case to 21%. This is not so very imporant because it is a percentage of only a small amount of steam. Probably it will reduce the 25% of apparent saving at economical load to 18%, and the 29% of apparent saving at the maximum load to 25%. These are important savings for they are percentages of large amounts of steam.

If the engine is running on 150 lbs. steam pressure instead of 100 lbs., the condenser will add 7 1/3% to the mean effective pressure; the cut off will be reduced from 80% to 61%, from 30% to 24%, from 10% to 6%; the apparent savings will be 19/82 or 23%; 6/32 or 19%; 4/12 or 33%; the actual savings will be perhaps 20%, 15% and 17% respectively.

These figures make it clear that the great saving due to the condenser comes at the periods of heavy loads, while they show that the percentage of saving at light loads may reasonably be expected to be as large or larger than the percentage of saving at economical loads. The engine carrying variable loads will therefore show a greater saving than the steadily loaded engine, for it will hold its own with the latter when the load is light or moderately heavy, and it will save very much more when the load is very heavy.

Theoretical Saving Due to Compounding.

The superiority of the compound condensing engine over the simple condensing engine is due to the fact that the steam can be expanded more fully in the compound engine, without this advantage being nullified by excessive cylinder condensation. Suppose that a compound engine at its normal load expands the steam nine times, while the corresponding simple engine expands it three times. Expanding the steam nine times instead of three, we get 55% as much power with 1/3 of the steam, or a theoretical increase in work per pound of steam of 65%.

Suppose these engines at their respective maximum loads expand the steam three times in the one case and none at all in the other. Expanding three times will give 70% as much power with 1/3 of the steam, or a theoretical increase in work per pound of steam of 110%. So here again, as in the case of the condenser, the great saving occurs at the maximum load. When the compound engine is running light it may be doubted whether there is any saving at all—whether in fact, there may not be a loss—but the amount of steam involved is small, and the saving during the periods of maximum load is so enormous that it may usually be counted on to make the poor performance at light load a matter of no great moment.

Tests on Engines with Extremely Variable Loads.

Saving Due to Running Condensing.

A large reversing engine rolling 19" x 20" ingots into 4" billets, in Cleveland, Ohio:

Non-condensing, February, March and April. Average 335 pounds of coal per ton of finished material.

Condensing part of the time—May—293 pounds of coal per ton of finished material.

Condensing, June, July, August, September—Average 245 pounds of coal per ton of finished material.

Saving by use of Weiss Condenser 27%.

A similar engine in Coatesville, Pennsylvania showed a saving due to the use of a Weiss Condenser of 26%.

Saving Due to Running Compound Condensing.

Results of tests of reversing engine at Johnstown, Pa.

"Johnstown, Pa., April 11, 1905.

"We consider the engine entirely successful and economical in driving a large slab mill, which is of course reversed as usual. It reverses promptly and easily without live steam and does not stall. It is working condensing. The engine has been repeatedly and carefully indicated by our own and Southwark engineers by continuous indicators showing the cards under all conditions and the average steam consumption per H. P. indicated is about half that of the ordinary high pressure non-condensing, reversing engines driving a blooming mill near by.

Yours very truly,
(Signed.) JOS. MORGAN,
Chief Engineer."

Results of tests at Cleveland, Ohio.

"Two simple non-condensing engines drove the Garrett Mill. They were changed to a cross-compound, condensing engine. Eighteen boilers formerly had difficulty in running the mill. Eight of these are shut down. The saving in coal has been 54%."

What Constitutes a Good Condenser.

A good condenser must be reliable, economical, and as simple as is consistent with reliability and economy. It must not lose the vacuum if there is a sudden overload, and above all things, it must never flood and allow water to get back into the engine. Therefore, it is best to force the condensing water in by a pump—for then the supply cannot so readily fail as it can if the vacuum draws the water in. And it is best to let the water run out by gravity down a barometric tube of large size, not contracted into a narrow throat, for then neither failure of the pump nor excess of cooling water, can flood the condenser. The air should be pumped out by a positive action pump, separate from the water.

It is perfectly possible to have the air pumped out by the jet action of the water, thus avoiding the use of an air pump, but such an arrangement is not as reliable as the use of an air pump, nor is it as economical of power. The air is not pumped for nothing, even though no air-pump is in evidence. The power to extract the air is furnished by the water, which must be under a greater head and in much greater quantity than is necessary when an air-pump is used.

The economy of a condenser is indicated by the temperature to, which it heats the condensing water, compared with the temperature corresponding to the vacuum obtained. If there are two condensers running under similar loads, and supplied with cooling water at 80%, and one heats this water to 120%, while the other heats it only to 100%, it is evident that the second will require twice as much cooling water as the first. The pumping of this water will prove a large item of expense.

When the load varies irregularly, it is necessary to be sure that the condenser will not lose its vacuum even if the maximum load comes on it suddenly. Very often this is done by running the condenser as though it were carrying the maximum load all of the time. Such a procedure is obviously wasteful. In the Weiss Condenser, which has been used more than any other for variable loads, there is a simple automatic vacuum regulator, which allows the condenser to be run with a small quantity of water, yet prevents the possibility of loss of vacuum, for the Weiss Condenser can boil when overloaded, yet will not lose the vacuum, as has been explained in describing the condenser at the works of the Southwark Foundry.

Ability to run at the ideal point is what makes for economy. It is practically impossible to run at the ideal point except in a "counter current" condenser, so it has become the fashion to call many condensers "counter current condensers." This is often a misnomer. When the air and the hot water are taken out of the same part of the condensing vessel, it is not a counter current condenser, and cannot run near the ideal point except at great cost of power to run the air-pump.

Aside from saving power in the air-pump, the counter current principle makes it easy to run the condenser at the ideal point, and in this lies its great value. Most condensers which do actually run on the counter current principle fail to take proper advantage of that fact, for they do not run at the ideal point.

Accumulator Condenser.

For situations where the load varies regularly, there has recently been invented a condenser which makes possible a great saving in the amount of water that need be pumped. This condenser is shown in Fig. 6.

This system requires about one-half of the cooling water that would otherwise be needed for the peaks of the load. The condenser, which is manufactured in America by the Southwark Foundry and Machine Company, of Philadelphia, is equipped with the Automatic Vacuum Regulator the same as the ordinary type of Weiss Condenser.

The cooling water enters the top of the condenser and after falling in a cascade is caught in a basin and runs into a large closed tank—the "accumulator."

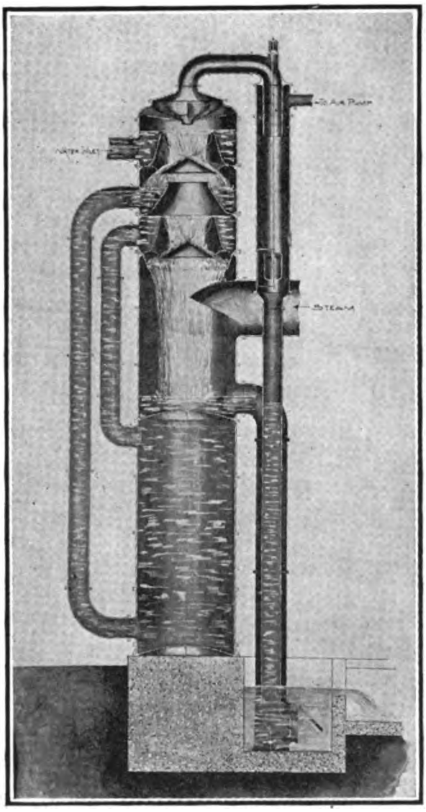


Fig. 6.

From the tank the water again enters the condenser and falls in another cascade, finally running out down the barometric tube into the hot well.

Small quantities of steam are condensed by the lower cascade. When large quantities of steam come, the water flowing over the lower cascade is insufficient to condense the steam, and it breaks through to the upper cascade, where it meets sufficient water to complete the condensation. As soon as this happens, warm water begins to flow into the accumulator, and if the heavy load continued the accumulator would become full of hot water and the lower cascade would become useless for condensing. The accumulator, however, is so proportioned to the period of heavy load, that it does not become full of hot water. Then, after the period of heavy load has passed, the hot water in the accumulator has time to run away, and the accumulator fills with cold water.

Farey & Donkin Method of Testing Engines.

When several engines are run from one boiler plant, it is difficult to test any one engine by the ordinary method of measuring the boiler feed, but the engine may be tested with almost equal accuracy if it exhausts into a condenser, where the tempertaure and volume of the cooling water can be measured.

The instruments needed are as follows:

1 A Venturi Meter in the pipe leading cold water to the condenser or else a weir in the hot well overflow.

2. Thermometers in the water entering and leaving the condenser.

3 Steam Engine Indicators to get the indicated horse power.

4. A Calorimeter to determine the dryness of the steam supplied to the engine. If there is a separator, the calorimeter may be dispensed with and the steam assumed to be dry.

Let x=the quality of the steam; *i. e.,* if the steam contains 2% of moisture $x=0.98$.

q=the "heat of the liquid," measured from 32° F.

r=the "heat of vaporization." (q and r may be obtained from any steam table.)

t^1=the temperature of the cooling water entering the condenser.

t^2=the temperature of the hot well.

H=B. T. U. per minute equivalent to the indicated horse power. [One I. H. P. equals 33,000 foot pounds per minute. One B. T. U. equals 778 foot pounds. So one I. H. P. equals $33{,}000 \div 778$ equals 42.4 B. T. U. per minute and H equals 42.4 x I. H. P.]

Q=B. T. U. per minute lost by radiation.

w=pounds of steam per minute entering the engine.

W=pounds of condensing water per minute entering the condenser.

All of the heat that gets into the engine is carried in by the entering steam. $xr+q$=B. T. U. in each pound of this steam as it enters the engine. Consequently $w(xr+q)=$ the total heat entering the engine per minute.

This heat that goes into the engine is disposed of in the following four ways:

1 A small part is turned into work=$H=42.4$ (I. H. P.).

2 A large part is used in heating the cooling water in the condenser=$W(t^2-t^1)$.

3 A very little goes away as condensed steam=$w(t^2-32)$.

4 A very little is lost by radiation=Q.

When this cannot be measured it may be assumed to be from 1% to 2% of the total heat received by the engine, depending on how well the engine is protected from the cold.

These are the only ways in which heat leaves the engine; consequently the sum of these four must equal all the heat that enters the engine, and

$$w(xr+q)=H+W(t^2-t^1)+w(t^2-32)+Q$$

$$w=\frac{H+W(t^2-t^1)+Q}{xr+q-(t^2-32)}$$

If W is measured by a Venturi Meter, w is easily found. If a weir is used instead of a Venturi Meter, it measures the quantity $W+w=K$ and the equation becomes

$$w=\frac{K+K(t^2-t^1)+Q}{xr+q-(t^2-32)+(t^2-t^1)}.$$

CHEMICAL APPARATUS FOR WATER PURIFICATION PLANTS

By THOMAS FLEMING, JR., MEMBER.

One of the most essential details of a water purification plant which involves chemical treatment, is an efficient and simply controlled chemical apparatus. It is a detail which is often neglected by the designing engineer and left by him to the tender mercies of the contractor. The result is that in many instances the plant is not only a partial failure as regards efficiency but is very uneconomical in operation.

It is not the purpose of this article to point out some of the failures of which the reader will likely recall one or more. While the writer believes that such an article would be of great value to the sanitary engineer, yet it is always a difficult matter to point out so-called blunders without wounding the feelings of those involved in the execution of the work and causing a useless and often bitter controversy. He will therefore confine himself to a brief outline of some of the conditions to be met and a description of a few installations with which his firm has been connected.

The chemicals most frequently used in water purification are sulphate of alumina, soda ash, lime, sulphate of iron, and hypochloride of lime. These chemicals must be placed in solution, and fed to the water in definite quantities. Some plants are equipped to handle a combination of one or more of these while at many, only one is needed. The chemicals to be used depend to a great extent on the nature of the water to be treated and the results desired. There are some instances where one or more methods might be used successfully and under these conditions the combination selected is largely a matter of judgment.

The most common treatment is the addition of sulphate of alumina to the water in small quantities, varying from a fraction to several grains per gallon. Where there is not sufficient alkalinity in the water to combine with the alum, lime or soda ash is added. Frequently hypochlorite of lime is used with alum during certain periods of the year. Iron sulphate and lime are more suitable for the coagulation of some turbid waters, especially those of the middle West, but are sometimes used at plants where the turbidity varies widely as an alternative to the alum lime treatment. It is not unusual to find a plant where all these chemicals are used at different times of the year. The amount used varies with the turbidity, color and chemical composition of the water to be treated and where used as a disinfectant with the bacterial count. Some waters are quite stable in composition and require little change throughout the year in the quantity of chemical used for treatment; others vary widely. The entire flow of the Monongahela River, which is the most difficult water in America to treat, is used for domestic and industrial purpose, over six times in the dry season before reaching Pittsburg. During this period it runs strongly acid while in the wet season and during high stages of the river, it is strongly alkaline. In addition at times after protracted droughts it is occasionally colored with vegetable matter that gives it a tea color. This is reported to be due to wild laurel which has been steeped in swampy places near its headwaters. This river also has a wide variation in the amount of suspended matter and it can be seen that under these conditions the amount and character of coagulant used will have a wide variation and the chemical treatment plant must be equipped with very elastic apparatus.

The success of a mechanical filter plant depends upon the proper coagulation of the raw water and an efficient setting out of the suspended matter in the preliminary settling basins. To obtain this coagulation economically the chemicals must be added so as to entirely combine in forming the floculent precipitate which settles out the suspended matter in the settling basin and forms the gelatinous "schmutzdecke" on the surface of the filter. This can only be obtained by efficient apparatus where the chemicals can be mixed in solutions of known strength and can be accurately fed to the water to be treated.

There are two methods of feeding the coagulant to the water to be treated, viz: by gravity or by pumping. These two methods divide the apparatus into two distinct types, gravity feed and pressure feed. In both types the apparatus may be further sub-divided into the mixing and solution tanks and the regulating apparatus. The method to be used depends upon local conditions. It is considered preferable to use the gravity feed where possible but there are sometimes cases where this is out of the question.

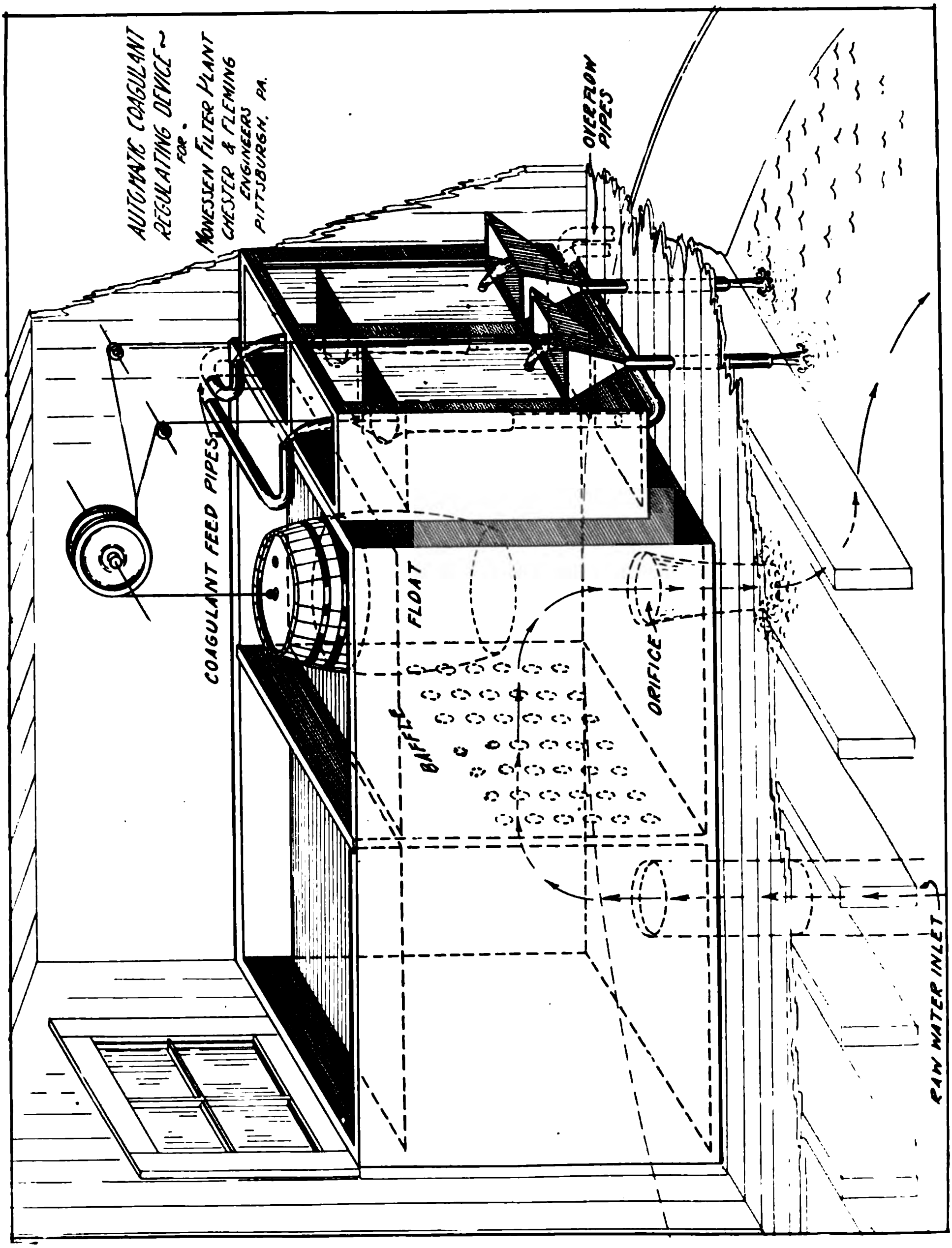
If the chemicals were easily dissolved in water and would remain in solution indefinitely the problem of mixing would be a simple one. Such however is not the case. While there is a variation in the solubility of the various substances, yet generally speaking it can be said that none of them are perfectly soluble in water to any degree of concentration without agitation. For large plants it is therefore necessary to provide mechanical or air agitators for the solution tanks to prevent a precipitation of the chemical in solution. For small installations it is customary to omit agitators on account of the extra expense and often on account of the difficulty of providing power and to allow for a certain amount of precipitation by feeding the chemical at a slightly higher rate. Where hot water or steam is available the practical operator will arrange to heat the solution. This simple expedient is of great assistance as it raises the point of solubility and in the case of slaking lime, greatly assists the chemical reaction. The great secret in the successful design of mixing and solution tanks is to furnish ample capacity for mixing the chemical in a weak solution. This is especially valuable in small plants where a concentrated solution in addition to the difficulty of mixing, will furnish such a small quantity in the outlet pipes that it will frequently clog up and will be very difficult to preserve a uniform flow.

For chemicals that are easily dissolved, such as alum, the mixing and solution tank are one and the same. The chemical is placed in a small compartment near the top of the tank and is dissolved as the tank is slowly filled with water. If the plant is of any size compressed air is blown through the mixture from a grid in the bottom or a mechanical agitator constantly stirs it.

Lime or hypochloride of lime should be mixed in a compartment separate from the solution tank to secure the best results, if there is a considerable amount used. It is customary to slake the lime in a separate tank and to drain off the saturated milk of lime solution to a solution tank. Hypochloride of lime must be thoroughly mixed by hand and then thinned out to a dilute solution for the solution tank. The solution tanks as well as the mixing tanks should be constantly agitated to preserve a uniform solution and to prevent precipitation.

The regulating apparatus that controls the feed from the solution tanks may vary from a simple gate valve to an orifice automatically controlled by floats or other devices. It is usually located below the bottom of the solution tanks and is connected to them by small piping. This piping should be sufficiently large to permit cleaning in case of clogging and should be of such material as will resist the corrosive action of the chemical to be handled. In some instances it has been found cheaper to use ordinary galvanized iron pipe and replace it as it wears out than to purchase brass pipe or lead lined pipe with a little longer life. This is especially the case with lime solutions. Lead pipe seems to be best adapted to hypochloride of lime solutions and brass pipe to alum solutions.

The details of the regulating apparatus will depend to a great degree on local conditions. If there is a uniform amount of water to be treated with a constant flow it is usual to feed the solution through an orifice, either varying the strength of the solution as the condition of the water to be treated changes or varying the size of the orifice or both. The capacity of orifice may be varied by using a variable orifice or by varying the head of the orifice. In case the flow of water to be treated varies, it may be necessary to further control the flow of the solution so that it can automatically vary in proportion to the flow. This can be


AUTOMATIC COAGULANT REGULATING DEVICE ~
FOR •
MONESSEN FILTER PLANT
CHESTER & FLEMING
ENGINEERS
PITTSBURGH, PA.
OVERFLOW PIPES
COAGULANT FEED PIPES
FLOAT
BAFFLE
ORIFICE
RAW WATER INLET

done by floating orifices or by an orifice controlled by floats. In pressure feeds under a varying flow of the water to be treated, a feed pump is attached to the pump handling the water to be treated. This feed pump is so attached that its strokes will be in proportion to those of the larger pump and the solution is very accurately introduced in proportion to the water pumped.

Apparatus for Charleroi Filter Plant.

The apparatus recently installed by us in the new Charleroi Water Company filter plant is of the gravity feed type. The water to be treated is Monongahela River water which as previously stated is very variable. The filter plant has a capacity of three million gallons and is equipped with a preliminary settling basin and six one-half million gallon gravity filter units. The coagulant house is located at one end of the filter house. It has been made quite elastic and ample space has been provided for meeting all emergencies. The coagulant house is a three story brick structure. It is 12 x 40 in plan and 30 ft. high. Only half of the two lower floors are used for the chemicals; the balance being used for the laboratory and reception room. The solution tanks rest on the second floor with their tops flush with the top floor which is used as a charging floor. There are five of these tanks. They are constructed of reinforced concrete and are 3-4″ x 4′ in plan and 9′ deep. Two of the tanks are used for alum, two for lime or soda ash and one for hypochloride of lime. The mixing is done in small compartments at the top of the tanks which are really a part of the main tank and the solution is kept constantly agitated by mechanical agitation. This consists of a set of horizontal paddles located approximately two feet from the bottom of each tank and attached to a vertical steel shaft. These shafts are geared at the top of the tank to a horizontal shaft which is driven by a belt connected to a water motor located on the floor below. Each vertical shaft is independently controlled by a clutch. The agitators in the lime tanks are further provided with four chains two feet long which hang vertically to the bottom of the agitator and prevent the lime from depositing on the bottom. The third floor in front of the tanks is reserved for charging and operating. The balance is used for storage. A hand elevator is used to bring the material up from the ground floor.

Each tank is provided with independent water connections. The outlets are located near the bottom of the tanks on the second floor and are controlled by standard orifice boxes of enameled iron. Each tank is provided with an independent orifice box. These boxes have a circular orifice in the bottom controlled by a cut off plate which is so arranged as to vary the size of the opening. This is controlled by a graduated dial and by setting the dial any desired rate of flow can be obtained. The inlet from the solution tank is controlled by a copper float and valve which keeps a uniform head on the orifice. From the orifice box the solution flows by gravity to the supply main leading to the settling basins.

The chemicals at this plant are mixed once each day. The duplicate tanks permit this to be done thoroughly while the solution is being fed from other tanks. Although the water is difficult to treat and makes rapid changes in composition, yet it has been possible for one man to operate this filter plant and the nearby pumping station and boiler house and to obtain excellent results. This is to a large extent due to the ample facilities for mixing and handling the coagulants. This arrangement of the apparatus is similar to that installed a few years ago by Mr. Chester for the filter plants at Portsmouth, Virginia, and South Pittsburg, Pa. It is the result of a long study of gravity feed of chemicals at various filter plants and its success cannot be attributed to any one plant.

Apparatus for the Monessen Filter Plant.

The apparatus for the Monessen filter plant comes under the pressure type of feed and involves some unique features which are the result of a study of peculiar conditions to be met. The filtration plant is located on a hillside above Monessen and the location is such that a pressure feed must be used. The coagulent house is a two-story structure. The solution tanks are located on the first floor and the second floor is used for storage. The main tank used for mixing is 10′ x 10′ in plan and 10′ deep and the top is flush with the charging floor. From this tank the coagulant is drawn off by gravity with smaller tanks on the lower floor. These tanks in turn supply a water lifter which discharges against a head of 40 feet into the raw water main leading to the settling basin.

As the pumps are located on the Monongahela River bank a mile distant, it is important to have an accurate control for the coagulent pump as otherwise coagulent would be fed to the settling basins when the main pumps stop and vice versa.

An automatic float control arrangement was designed for this purpose. A cubical compartment 4 x 4 x 4 ft. deep was built on the upper end of the raw water pipe where it enters the settling basin. This compartment is placed above the flow line of the basin and a circular orifice is cut into one side at a point 18″ above the bottom. This orifice is 10″ in diameter which is sufficiently large to discharge the maximum pumpage without overflowing the compartment. The inlet pipe enters at the bottom of the compartment and is baffled to prevent too much disturbance to the water in the compartment. A large float consisting of a whiskey barrel completes this part of the apparatus.

The coagulant pump lifts the solution to a set of feed boxes located sufficiently high above the raw water compartment to discharge by gravity. Each of these boxes is 8″ x 8″ x 5′0″ deep. It has a plate glass front and a small orifice drilled in the front near the bottom. In the center of the compartment is a horizontal movable orifice connected to a return pipe and controlled by a rope. The rope is attached to a reversible pulley which is also attached to the large float in the raw water compartment. It is arranged so that the slightest rise or fall in the float will give a corresponding rise or fall in the horizontal orifice overflow in the feed boxes, thereby preserving a proportionate head on the small orifices. The overflow from the horizontal orifice flows through a return pipe to the solution tanks to be repumped to the boxes. The quantity of coagulant used is controlled by varying the strength of the solution.

Apparatus for the Pennsylvania Water Company.

The Wilkinsburg filter plant of the Pennsylvania Water Company is equipped with chemical apparatus very similar to that used at Charleroi. The plant has a capacity of 10,000,000 gallons per twenty-four hours in comparison to the 3,000,000 gallon capacity of the Charleroi plant. However, Allegheny River water is handled, and this is partly clarified by a crib in the river, so that the conditions to be met are much more favorable and very little more solution tank capacity is needed than in treating the smaller quantity of Monongahela River water.

The main feature of this apparatus is the method of control. Instead of standard orifice boxes, a special form of box was designed which has proven very flexible. This consists of a reinforced concrete compartment approximately 2 x 2 in plan and 5 ft. deep. The front of this compartment is plate glass and to this is bolted a circular brass plate, the bolt being through the center of the plate and controlled by a thumb screw. Near the circumference of this place are a series of circular orifices ranging in size from a fraction of an inch in diameter to several inches in diameter. On the same radius in the plate glass front of the orifice box there is an orifice slightly larger than the largest one in the plate. By revolving the plate any one of the orifices in it can be brought over this opening, thereby changing the discharge. The plate glass and the ground metal surface of the brass plate prevent any leakage around the orifice. There is a large copper float in the compartment which is adjustable and controls the inflow pipe from the solution tanks. By adjusting this float further elasticity in control of the solution can be obtained by raising or lowering the head of the orifice.

Apparatus for Valley Camp.

The Valley Camp equipment is different from the types previously described. It is to be used to disinfect the effluent from a sewage plant and handles hypochloride of lime only.

It is located in a small frame building near the outlet end of the disposal plant and consists of two wooden solution tanks and the control apparatus. The solution tanks are to be located on a platform several feet above flow level so as to give sufficient room to feed by gravity through the control apparatus which is located on the floor.

These tanks each have a capacity of one day's maximum supply of hypochloride solution. The hypochloride is to be mixed by hand in a bucket and then diluted in the solution tank. Each tank is provided with running water connections. The outlet is located near the bottom and is connected by a one-inch valve connection to a galvanized iron feed pipe which leads to the control box This box is located on the floor at one side of the tanks. The inlet from the tanks is controlled by a float valve and the outlet consists of an adjustable orifice which feeds through a funnel to the disposal plant effluent in the sewer below the floor. The flow of this sewage is very variable and in order to prevent any undue wastage of the chemicals it is necessary that it should be automatically controlled so as to feed at a given rate in direct proportion to the amount of sewage.

The adjustable orifice is therefore arranged as follows: It consists of a ¼″ glass tube bent so as to discharge downward and connected by a rubber tube to an opening of the same size in one end of the feed box. This tube it attached to a brass clamp which runs in a vertical slotted groove along one side of the box to which is attached a graduated scale. The clamp is connected by a small steel wire to an overhead pulley wheel. This wheel is in turn connected by a wire to a float which is adjacent to the outlet sewer under the floor of the building. There is a triangular notched weir in this sewer so that the heights of sewage in the float chamber can be made to accurately correspond to the different rates of flow of the sewage. The pulley wheel is differential and in this case at a point just below the flow line of the control box for a zero reading over the weir in the sewer. Then for any increase in the sewage flow the orifice will drop four times the distance that the float rises and with the drop the flow of chemicals will increase. The ratio to be used depends on the amount of chemical to be used and size of orifice. This method of feed has been found by the writer to be the most successful for handling hypochloride of lime in small plants where the amount of solution used is very small. Standard control boxes are as a rule failures as the orifices quickly clog up. A comparatively large orifice such as the above with a variable head has proven very satisfactory and is simple in adjustment.

A NEW MAGNETIC SWITCH CONTROL SYSTEM

By C. Pirtle.

Presented before the Society, March 13, 1911.

Any electrical control system must be based fundamentally on one or more forms of switching devices. The simplest switching device is touching and separating the wire conducting the current of electricity and examples of this simple form are the telegraph key and the telephone switch operated by taking down and hanging up the receiver. For any except very small currents a larger contact area must be provided so the knife blade switch and sliding contact were devised when the advent of the dynamo made available larger currents at higher voltages than had been obtainable from batteries.

The electric current was first used solely for lighting and these devices did very well for the relatively small currents at the relatively low voltages then used. When it was found that the dynamo used to convert the mechanical energy of a prime mover, such as the steam engine, into electrical energy could also be used to reconvert this electrical energy into mechanical energy the electric motor came into existence. For the small sizes first produced the simple knife switch and sliding contact were successful and are still used although not entirely satisfactory.

Remote control or control of electric motors from a distance was first proposed for elevator service and was effected through the agency of magnetically operated switches. Eickmeyer in 1891 devised such a system and his work was followed by Sprague who perfected a system during the years 1894 to 1896 and a great many of these Sprague Elevator Magnetic Controllers are still in operation. About this time, 1896, the dirt and noise of the steam engines pulling the trains on the elevated roads in Boston, Chicago and New York caused a demand for electric operation of these trains. Single street cars electrically driven had become the standard and displaced not only the horse drawn car but also the cable roads. To adopt the electrically driven street car for operation in trains to meet this demand some system of remote multiple control was necessary because every car or every other car had to be motor driven and all had to be controlled from the head end of the first car. Sprague developed such a system and the trains on the Boston Elevated were operated electrically in 1898. Since then automatic magnetic switch control has been very widely applied and the company with which I am connected has been and is one of the leaders in this development. It is being predicted that automatic magnetic switch control will become the standard and will eventually displace all other forms.

Just as steam must be admitted slowly to an engine starting cold and from rest so the current input to a motor must be limited during acceleration. This is accomplished by inserting resistance in the motor circuit and gradually cutting it out as the motor comes up to speed. This resistance is designed to remain in circuit only during the short time of starting. If the resistance is cut out too slowly it overheats and is liable to burn out. If cut out too fast too much current is allowed to flow through the motor with consequent electrical and mechanical strains and danger of burnout, grounding, and commutator trouble. With the ordinary manually operated starter the rapidity with which the resistance is cut out is subject to the personal equation of the operator and is not done properly except by chance. Operators are almost invariably either too careful and slow and so overheat the starting resistance or are too impetuous and fast and overload the motor. The motor should be accelerated reliably with a fixed maximum current input, this maximum current input being fixed by the electrical engineer and not by a careless or ignorant operator. This gives the following valuable results:

1st. Motors may be invariably brought up to speed with maximum safe acceleration thus assisting in maintaining the output at a maximum.

2nd. Delays due to both electrical and mechanical breakdowns are greatly reduced by limiting the current during acceleration and reversal. This, of course, has an important bearing on both output and maintenance cost.

3rd. Acceleration of the motor by means of a controller which automatically interprets operating conditions, leaves it to the operator to simply push or pull a lever, or push a button, as far as starting or stopping is concerned. Consequently less skilled workmen may be employed or where skilled workmen are necessary they can devote all their skill to their work. The combination workman and motorman becomes a workman pure and simple.

There have been a number of automatic acceleration control systems that were successful in relieving the workman of this responsibility and effecting the results above mentioned but none of them have been entirely satisfactory. Some merely limit by a dashpot the time of cutting out the resistance and act irrespective of the load on the motor and these are little better than manual control except they provide for operation from a distance. Others will not operate if the voltage is too low or too high but the great disadvantage of all of them is complication.

The diagram of connections of such a controller is a mass of lines including main circuits and shunt circuits, main contacts, auxiliary contacts, relays, and from six to a dozen or more interlocks or control circuit contacts or butterflies. Such a wiring diagram cannot be understood by an ordinary "monkey wrench electrician." Special knowledge gained only by special training or extended experience is necessary.

Excessive delays are experienced by the short-circuiting of control circuit wires and contacts or operating coils subjected to full line voltage, wound with wire as fine as a hair.

Knowledge and skill are required to quickly diagnose the trouble with such a magnetic controller and make the necessary adjustments or repairs.

Therefore, the greatest improvement which can be made in magnetic controllers lies in the direction of the elimination of complication.

The company with which I am connected, as the result of long continued research and experiment, is able to announce the perfection and standardization of magnetic controllers and motor starters "reduced to their lowest terms."

In this simplified magnetic controller there are no control circuit contacts or butterflies carried by the reversing switches or the resistance switches.

The switches are caused to close in an orderly sequence (that is, the second switch cannot close until the first switch is closed, the third switch cannot close until the second switch is closed, and so on) ; this result being obtained without the use of control circuit contacts or butterflies.

The main switch or reversing switches are interlocked against failure of any of the resistance switches to open, thereby preventing application of current till all of the accelerating resistance is in circuit with the motor, this interlock being also obtained without the use of control circuit contacts or butterflies.

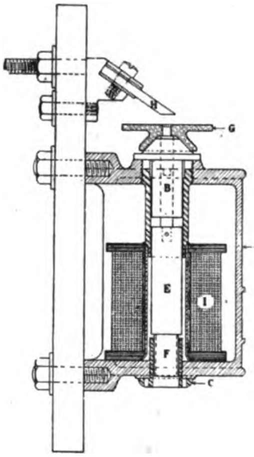
The operating coils of the resistance switches instead of being wound with wire as fine as thread are wound with wire or copper strap as heavy as the series windings of the motor, and instead of being subjected to full line voltage of say 220 volts, each coil is subjected to an insulation strain of a fraction of a volt.

The operating windings of the resistance switches are in fact in series with the motor, and the characteristics of the resistance switches are such that the switches remain closed till the motor current has been reduced to practically zero. There is, therefore, no arcing at the contacts of the resistance switches, and no need of blow-outs or other arc-rupturing devices on these switches.

Each resistance switch in addition to its functions as a switch embodies the functions of a series relay by means of which the maximum accelerating current may be fixed at will. Automatic current limit acceleration is therefore obtained without the use of one or more separate relays responsive to the motor current.

Plate No. 1 is a cross section of one of these new series wound switches. This switch comprises a "C" shaped magnetic frame A, which is provided at its upper arm with a movable plug B, and at its lower arm with an adjustable annuller plug C. E is the plunger, which is provided at its lower end with a steel extension F, and at its upper end with a contact maker G, which is adapted when the switch closes to make contact with a pair of laminated brushes H. I is the magnetizing winding adapted to be connected in series with the motor to be controlled.

The switch possesses the following remarkable characteristics: If a current lower than a certain predetermined value is passed through the winding the switch will close and will be held closed till the current is reduced to practically zero.



TYPE A SWITCH

Plate 1.

If a current above a certain critical value be sent through the winding, the plunger of the switch instead of going up and closing the switch, actually tends to go the other way. In other words, the switch is held open until the current has been reduced (by the speeding up of the motor) to the predetermined accelerating value, and when this value is reached the switch will automatically close.

The value of current below which the switch will close and above which the switch will lock out or refuse to close is adjustable through a wide range. Each switch is therefore a combined switch and series relay, the combination making a very simple and sturdy unit with a very wide range of application to electric motor control.

The curves plate No. 2 show the operating characteristics of one of these switches. The absisca of these curves represent air gaps between the lower end of the plunger and the upper end of the adjustable plug in fractions of an inch. The ordinates of these curves represent ampere turns in the winding. If the winding had but one turn the scale would read amperes.

Curve A shows the minimum ampere turns at which the switch will close. You will observe that this curve is substantially a horizontal line through the entire range of adjustment, so that the minimum current at which the switch will close remains substantially constant.

Curve B is the operating or closing curve.

The switch will close at any value of current between the curves

A and B for the corresponding adjustment. If at any point in the range of adjustment the motor current is greater than the ordinate of the curve B indicates, the switch will not close but will lock out till the current has dropped to the value shown by the curve at any point.

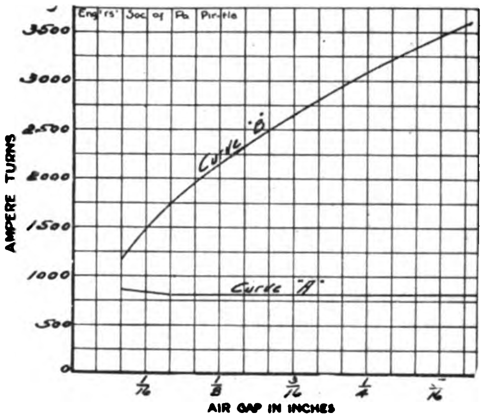


PLATE 2

Plate 2.

Now as to just how and why this switch operates in the way it does we will disregard fine spun theory and review the matter from the standpoint of applied engineering, and from this standpoint an explanation which will answer the purpose, can be given.

Referring to the cross section of the switch, you will see that the operating plunger lies between two poles—one the plug in the upper arm of the frame, and the other the annular face of the adjustable plug in the lower arm of the frame. The lower end of the plunger is provided with an extension passing into the lower plug. Considering the path of the magnetic flux through the magnetic circuit of the switch practically all of the flux set up will pass out of the upper end of the plunger in a direction at right angles to its upper face. As you very well know, this flux will set up an upward pull on the plunger tending to lift the plunger and close the switch, and the amount of this pull will be proportional to the square of the flux density.

Looking now at the lower end of the plunger, it is seen that the magnetic flux can enter it by two paths. One of these paths is from the frame and into the extension of the plunger. Most of the flux through this path enters the plunger horizontally and hence it produces little magnetic pull in a vertical direction. The other path of the flux is directly into the lower end of the body of the plunger through the shoulder next to the extension. The direction of this flux is substantially vertical and therefore produces a magnetic pull tending to move the plunger downward. The plunger is then subjected to two opposing magnetic pulls. Considering again the lower end of the plunger, as mentioned before, the flux enters it through two paths, and of course the flux divides in inverse ratio to the reluctances of these paths. When the magnetizing force is high (in other words, when the current in the winding of the switch is high) the extension of the plunger is practically saturated and therefore offers a high reluctance, and consequently a larger proportion of magnetic lines pass through the air gap vertically and into the lower shoulder of the plunger, and the downward pull on the plunger is high.

When the current in the winding of the switch is lower a larger proportion of the flux passes through the extension and a less proportion passes vertically into the lower shoulder of the plunger. Consequently the downward pull on the plunger is less.

If the current in the winding of the switch is above a certain value, the downward pull on the plunger plus the weight of the moving part of the switch is greater than the upward pull due to the flux passing out of the upper end of the plunger and the switch cannot close. With current lower than this the upward pull is greater than the downward pull plus the weight of the moving parts and the switch will close.

The critical value of current below which the switch will close and above which the switch will lock out or refuse to close is adjusted by adjusting the lower air gap by means of the adjustable plug.

It must be apparent now that this switch is a self-contained switch and series relay.

Plate No. 3 shows the diagram of a simple starter connected with a shunt motor. The knife switch closes the motor circuit through the coil of the first resistance switch S1 and the resultant current flow being greater than the value for which the switch is adjusted the switch will lock out and will not close until the current has been reduced by the speeding up of the motor. When switch S1 closes it closes the circuit through the winding of switch S2 and cuts out of circuit resistance R1 which permits a current flow sufficient to lock out switch S2. Switch S2 will then not close till the current has fallen again due to the further speeding up of the motor. Finally switch S2 closes cutting out all of the starting resistance, and short-circuiting the operating coils of both himself and switch S1. Also when switch S2 closes, its little holding coil is energized which prevents it from opening and both the operating coils being short circuited, switch S1 opens. When it is desired to stop the motor the knife switch is opened. It will be observed that since switch S1 locks out when the knife switch is closed the number of acceleration points is one more than the number of magnetic switches used.

In the case of plate No. 3 the number of switches is two and the number of acceleration points three. It is evident that more automatic acceleration points can be obtained by adding more switches.

In manually operated starters the resistance is divided into a considerable number of steps, not because they are necessary as acceleration points but to keep the voltage drop between, steps low enough to prevent destructive arcing.

Each size E. C. & M. Automatic Motor Starter is furnished so that a choice can be made in the number of acceleration points dependent upon the service. A small motor does not require as many acceleration points as a large motor and a motor driving a load having little inertia does not require in starting as many acceleration points as the same size motor in starting a load having large inertia such as a punch press with heavy fly wheel.

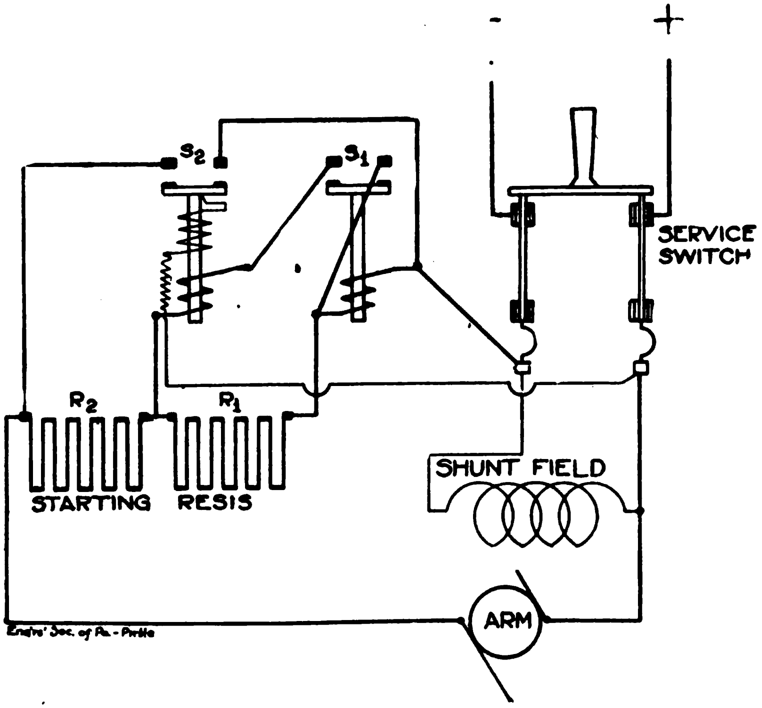


Plate 3.

E. C. & M. Automatic Motor Starters start the motor always in the shortest possible time consistent with the load and its character. For instance, a 10 HP. three switch starter would start a punch press with heavy fly wheel in 10 to 12 seconds and would start a motor belted to a machine tool with the clutch out in about one second. The operator needs only to open and close the knife switch and the starter will do the rest, always protecting the motor by limiting the current input during starting and timing the period of starting to the load and its character. It is also evident from plate No. 3 that the knife switch can be put at any convenient point so that the operator does not have to go to the starter to start and stop the motor.

Plate No. 4 shows an E. C. & M. Automatic Motor Starter arranged with circuit breaker and remote control features. The remote control can be effected either by push buttons as shown or by float switch or pressure gauge. In this case three acceleration switches are shown and it will be seen that when switch S3 closed current is cut out of the operating coils of all three switches and switches S1 and S2 open. In this form of starter the closure of the knife switch does not start the motor but simply closes the circuit from positive through the normally closed opening button, through the preventive resistance, through the contacts of the overload coil, through the operating coil of the shunt wound circuit breaker switch to negative. The preventive resistance does not allow a current flow sufficient to close the shunt wound circuit breaker switch but only enough to hold it in the closed position.

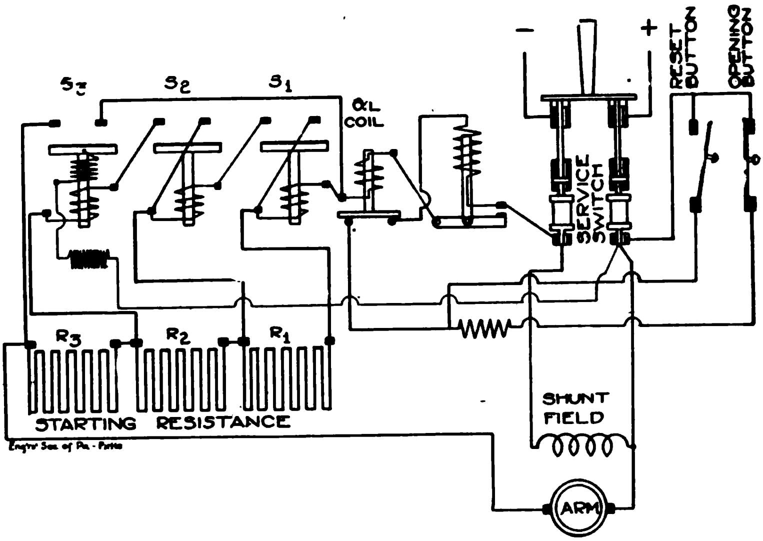


Plate 4.

Now if the normally open reset button is pushed the preventive resistance is momentarily short circuited and full line voltage applied to the shunt wound operating coil of the circuit breaker switch which closes instantly. When the pressure if taken off of the reset button sufficient current flows through the opening button and preventive resistance unit to maintain the circuit breaker switch in the closed position but when the opening button is pushed this current is interrupted and the circuit breaker switch opens instantly.

It is evident that as many opening and reset buttons as desired may be used, the reset buttons being connected in parallel and the opening buttons in series. If the current at any time rises above the value for which the overload coil is adjusted its plunger will rise and interrupt the current through the operating coil of the circuit breaker switch which will open instantly.

To start the motor again it will then be necessary to push the reset button. When the circuit breaker switch closes, the motor is started and accelerated as previously described upon closure of the knife switch in plate No. 3.

The E. C. & M. Type "A" series switch being a rugged simple self-contained switch and series relay improves and simplifies not only the starting of motors but also their control for almost any service. Several eminent engineers have declared that thus series switch is the most important development since the advent of magnetic switch control. A number of the largest operators in the country agree that this series switch will do away with 90% of the troubles and objections to magnetic switch control.

In conclusion several plates showing starters and controllers in their commercial form will be shown and a small demonstrating outfit will be operated.

SPECIAL NOTE: The Editors regret that proper acknowledgment was not made in the May, 1911, issue, of the courtesy of the Engineering News to whom the Journal is indebted for the use of illustrations used in the paper on the St. Louis Municipal Bridge by Mr. Henry W. Hodge.

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LUBRICATING OIL

BY DR. FREDERICK W. MANN.*

On February 3rd, 1911, Chief Engineer Nelson P. Lewis, of New York, declared that "the roads of every civilized country will have to be rebuilt, because the old Macadam, the best thing until now for highways, is unable to stand the grind of automobiles."

He states further "that only a bituminous substance, such as tar, asphalt or mineral oil, should be used as binding material for loose rock and sand," etc.

What is Wrong with our Fine Old Macadam Roads?

We understand now that the good old mare drawing her load over the highway was a benefit to the road; the wheels of the vehicle acting like a steam roller on the macadam; while our modern auto is not "drawn" any longer but it is "driven" over the road. The two rear wheels of the auto are identical with the driving wheels of the locomotive. It is the friction, the resistance produced by the driving wheels of the ponderous locomotive, gripping the underlying rails, that starts the Empire State Express on its sixty miles an hour trip. It is the same grip of and friction-resistance produced by the rear wheels of the auto on the macadam road, which sends the road a-flying into the air as a cloud of dust. In the case of the steel road we have given the driving-wheels of the locomotive a proper, unmovable, well ballasted rail track to withstand the grind, the friction of the driving wheels. For the auto drive-wheels it is up to us to do something pretty soon; as a matter of fact, the different states are now contemplating to improve their highways.

Again: let us watch for a moment the engineer on the locomotive or the Empire State Express, as his train is flying through York State on its fast trip to Buffalo. There is an obstruction ahead of him, seeing it he turns on the air-brakes and opens the sand-boxes. He stops the train almost instantly. By what? Again by friction. The gripping-shoes of the brakes bring the flying wheels to an instantaneous standstill, the sand assisting by roughing the smooth polished lubricated surfaces of the rails.

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*Read before the Venango Engineers' Club, Oil City, Pa., April 27, 1911 and printed in the Journal of the Engineers' Society of Pennsylvania, on request of G. F. Roess, President of the Venango Engineers' Club.

Another case is that of a pulley on the main shaft in a large works. The pulley is well set and its journals run fine, well lubricated in their bearings, with no friction. Over the pulley and connecting the drive wheel of the large engine spans the twenty-four inch belting, which sets the pulley on the main shaft in motion, and as the steam is turned into the engine cylinder, instantly the big works commences to hum and shows life and activity in every corner. What causes it? Answer: Friction. The grip of the belting on the pulley.

Another case of grip or friction is that of a six or more horse team, loaded with a few barrels of Crude, pulling along in the mud of the old road on Oil Creek, coming from Drake's well at Titusville. The horses are working bravely, up to their bellies in the mud, and finally are hopelessly stuck, until relief comes. Cause: Friction. Some of you may recollect such a sight. Some of you may also see at some future day the same old road converted into an "anti-friction", well-lubricated road, free from dust and mud, and the auto trucks flying over it in both directions and in all seasons, loaded with the products of the land and shops along the road.

These cases show that we need friction to start and to stop motion, and lubrication to keep up motion, or to overcome friction. Therefore, in order to understand something about lubrication, we need to know something about Friction and in order to become familiarized with this subject, it will be wise to begin at the start and to hear what some other people have said and done on the subject.

Let us start with our old friend Webster.

Webster gives the following definitions:

Lubricus......	is the Latin for slippery.
Lubricant.....	substance as oil, grease, etc., used for reducing the friction of the working parts of machinery.
Lubricate	to make smooth or slippery.
Oil	any one of a great variety of unctuous, combustible substances, not miscible with H_2O. They are of animal, vegetable or mineral origin. The mineral oils are varieties of Petroleum (Rock Oil), Mineral Oil or Natural Oil, consisting of a complex mixture of various Hydro-carbons, largely of the Methane series. The vegetable oils are of two classes, essential oils and natural oils, which in general resemble the animal oils and fats. Most of the natural oils and

	the animal oils and fats consist of ethereal salts of glycerine, with a large number of organic acids.
Friction	from the Latin frictio, fricare, to rub: The act of rubbing the surface of one body against that of another. The resistance which a body meets with from the surface on which it moves. It may be resistance to sliding motion or to rolling motion.

The "Century" has this to say in connection with the subject—Lubrication:

Lubricant-tester	A form of testing machine for determining the lubricating values of oils. This tester acts by recording the friction developed under a given power.
Lubricating Oil.	Any oil that is used or is suitable for lubrication, specifically a thick oil produced in the process of refining Paraffine Oil and Petroleum.
Oil	The general name for a class of bodies which have all or most of the following properties in common: they are neutral bodies, having a more or less unctuous feel and viscous consistence; are liquid at ordinary temperatures; are lighter than water and are insoluble in it; but dissolve in alcohol, and more readily in ether, and take fire when heated in air, burning with luminous, smoky flame. The oils are divided into three classes, which have very different chemical compositions and properties; the fatty or fixed oils, the essential or volatile oils, the mineral oils. The fatty or fixed oils leave a permanent, greasy stain on paper, are distinctly unctuous to the feel and differ from fats chiefly in being liquid at ordinary temperatures. Both are tri-glycerides of the fatty acids. The fatty oils are of both animal and vegetable origin and are sub-divided into the drying and non-drying oils. The former class includes all oils which thicken when exposed to the air through the absorption of oxygen, and are converted thereby into varnish, as for example, linseed, nut, poppy and hempseed oils. The non-drying oils, when exposed to the air also undergo a change, induced by fermentation, resulting in the formation of acrid, disagreeable smelling acid substances. The fixed vegetable oils are generally prepared by subjecting the seeds of the plant to pressure; the animal oils are for the most part the fluid parts of the fat of animals. Fixed oils are used as lubricants. Essential or volatile oils are generally obtained by

distilling the vegetables, which afford them, with water. They are acrid, caustic, aromatic and limpid, and are mostly soluble in alcohol, forming essences. They boil at a temperature considerably above that of boiling water, some of them undergoing partial decomposition. Chemically considered some are Hydrocarbons (terpines) but most of them are mixtures of terpines with certain camphors and resins. They absorb oxygen quite rapidly, producing ozone, which gives to them bleaching properties.

Mineral oils, Petroleum and its derivatives, are mixtures of Hydrocarbons, some being exclusively paraffines others containing varying quantities of Hydrocarbons of the olefine and benzene series. They are only of mineral origin, while the fatty and essential oils are solely of animal and vegetable origin. The mineral oils are now most largely used as sources of artificial light. Oil has been used for religious and ceremonial purposes under Judaism and Christianity, as well as in other religions.

Petroleum ....(Petra-rock), (oleum-oil). Was known to the Persians, Greeks and Romans under the name of Naphtha. The less liquid varieties were called Asphaltos by the Greeks, and bitumen was with the Romans a generic name for all the naturally occurring Hydrocarbons, which are now included under the name of Asphaltum, Maltha and Petroleum. The existence of Petroleum in Penn'a. and N. Y. has been known from almost the earliest time of the settlement of these states by Europeans; but it was not until 1859, when oil was first obtained from artesian wells at Titusville, on Oil Creek (Col. Drake's well).

The Brittanica gives the following definitions and explanations:

Lubricants....are fluids which are interposed between solid machine surfaces that are required to slide on each other. The object is to lessen the friction, which is injurious, both in wearing away the surfaces, and thus destroying the fit between them, and in dissipating and rendering useless part of the energy transmitted through the machine. The difference between the wear on unlubricated and that on lubricated surfaces is so serious that a comparison between the cost of lubrication and the money saving in avoidance of repairs is superfluous. But the difference in wear when two different lubricants are used is not very great and the proper choice between the two lubricants depends on a comparison of their cost with the amount of working power they save from dissipation. Of the commonly used oils the higher priced are much more efficient as lubricants. Of the animal oils and fats suitable for lubrication those commonly used are sperm, lard, neatsfoot, tallow and common whale oil. Of the vegetable oils—olive, cottonseed and rapeseed are extensively employed. Various fish oils are also much used and mineral oils now form a large proportion of the many lubricating compositions that are in use. For machinery where considerable pressure is exerted between the bearing surfaces, the mineral oils are too thin, or, as it is termed, are too wanting in "body" to be quite suitable without being mixed with an animal or vegetable oil. The same oil may be used several times over.

The oil gets gradually worn out as a lubricant by becoming filled with dirt, partly the dust of the atmosphere and partly the minute iron "and brass" dust that is continually rubbed off the bearing surfaces. Oils that have been used for two or three times can be to a certain extent repurified by washing in a solution of carbonate of soda or potash and Chloride of Calcium in boiling water. But it must not be supposed that with repurification an oil may be used an indefinite time as a lubricant. A large portion of it is actually evaporated by the heat caused by the friction at the journal, and the unevaporated portion seems to undergo some chemical change, injurious to its lubricating properties. Vegetable oils are peculiarly rich in volatile constituents and it is this fact probably, even more than the greater cheapness of mineral oils, that has led to the largely increased use of the latter in the lubricating of machinery.

The quality of an oil may be tested by chemical analysis; by measurement of density and viscosity; by observation of the temperature necessary for ignition in the atmosphere, or, as it is called, the "flashing" temperature; by the measurement of the temperatures to which a journal rises when running at different speeds and under different pressures, and when supplied with a given amount of lubricant per minute, and by the measurement of the co-efficient of friction at the same journal with varying speeds of rotation and pressures. The last two methods of test are the most interesting and directly useful from a mechanical point of view; i. e. considering the oil as a lubricant simply.

The machine designed by Prof. Thurston of the Stevens Institute of Technology is the best that has yet been constructed to carry out these tests. With this machine Prof. Thurston has obtained extremely interesting results regarding the variation of the co-efficient of friction with temperature, pressure and velocity of rubbing. These are summarized as follows: With great intensity of pressure and low velocity the friction increases as the temperature is raised; but for each low velocity the rate of increase of friction with temperature becomes slower as the pressure diminishes, and becomes Zero at a certain limit of pressure, which is higher the higher the velocity is. With high velocity the variation of friction with temperature is in the opposite direction within the limits of pressure commonly used.

Again, at a given temperature and a given pressure the friction first decreases very rapidly with increase of velocity, and then above a certain limit of velocity increases again slowly with further increase of velocity. The limit of velocity at which the direction of variation changes from negative to positive does not appear to depend on the intensity of pressure, but the change occurs at much lower velocity-limits with low than with high temperatures. Thirdly, with a given temperature and a given velocity the co-efficient of friction, i. e., the ratio of friction to normal pressure, at first decreases rapidly with increase of pressure at low pressures, and then at high pressure increases again with the pressure. This law seems to hold for all temperatures and all velocities; but how the limit of pressure at which the variation changes in direction is altered by alteration of temperature and velocity is not as yet certainly determined.

There are so many valuable and interesting points accumulated in these citations from leading Encyclopedias and Dictionaries that it was necessary to refer to them broadly, leaving it to the individual most interested to look them up for further details.

In a general way we may define "Lubricating Oils" as liquid, greasy, slippery, unctuous, neutral bodies, insoluble in water, free from volatile matter, gum and acid, and used for preventing or reducing friction.

Friction is the resistance produced by two bodies coming in contact in a sliding or rolling motion. The products of this resistance or friction is in the first place a raise of temperature. For an example, think of the setting afire of a piece of wood by rubbing it hard with another piece of wood—the old Indian match; or, think of the hot boxes of railroad coaches and cars, when not, or insufficiently, lubricated. Friction requires power to produce it, therefore this amount of power is lost for other purposes. Friction stands also for waste of energy, waste of money.

Friction is destructive, it means loss of material. I bring to mind a steel saw cutting through a log, making the sawdust fly, or a piece of tool steel cutting a thread on a bar of iron in a lathe. These cases also show that sometimes we make good use of the destructive action produced by friction.

Besides these physical changes we may start many serious chemical changes by friction, especially oxidations and decompositions, also electric currents, even producing live sparks. Many a serious conflagration in Oil Refineries, Paint and Varnish, and other Works, was traced to live sparks produced by friction.

There are two other words which we constantly use in connection with the subject of Lubrication and which need to be defined. I have reference to "Adhesion" and "Cohesion."

By "Adhesion" we refer to the adhering, sticking properties of one body to another body, penetrating its pores and giving it a slippery surface.

By "Cohesion" we refer to the intermolecular clinging together of the parts of the same body. For instance, a drop of water on a smooth piece of writing paper or polished iron rolls over it, at the will of the operator. It does not adhere, does not penetrate quickly. It has no adhesion, but much cohesion. It is not a lubricant. Or, take a drop of Kerosene Oil or light machinery oil, on the same smooth piece of writing paper, instantly it penetrates the pores of the paper, forming a grease-spot, giving the paper a slippery surface. In the same way the oil acts on the polished iron. It shows much adhesion, very little cohesion. It is a lubricant.

Think of a powerful machine of modern times, say a 5,000 H. P. engine, and alongside the tiniest ladies' gold watch just covering the nail of your thumb. How absolutely helpless both are, without the proper lubricant! Without a film of lubricating oil between their journals and bearings! The same holds good for everything, including the human machine, and shows that we apply lubricating oil to avoid the coming in contact of rubbing surfaces, resulting in friction, which means—STAND STILL.

The shortest definition for the "ideal" Lubricating Oil is—the oil whose adhesion is infinite and whose cohesion is nil. As friction stands for STAND STILL and death, so its opposite, lubrication, stands for MOTION, activity, life.

Another word we meet is the "Friction Coefficient." By this we mean the relation which the friction holds to the normal pressure. Friction-resistance divided by the normal-pressure is the "Friction coefficient."

William M. Davis in his practical little handbook on "Friction & Lubrication" defines it as follows: "The relation that the power required to move a body bears to the weight or pressure on the body." If it takes a force or pull of 7 lbs. to move a weight of

50 lbs. the Friction Coefficient is $7 \div 50 = .14$, or it will require .14 of a pound of force to move 1 lb. of weight or pressure. The Friction Coefficient is of great importance for the determination of the best suited lubricant. As investigation progresses in this determination, more and more variables of a complicated nature arise, in other words—as Mr. Davis expresses himself—"determining coefficients of friction is in some respects much like the definition of the practice of medicine given by a certain famous physician, when he spoke of it as the Science of guess-work." Here is a chance, an opening for doing some good work.

The Friction Coefficient of not lubricated surfaces depends on,

1. The material of the rubbing bodies.
2. The degree of finish or polish of the rubbing surfaces.
3. The velocity of the motion. The Coefficient decreases with increasing velocity.

The Friction Coefficient of lubricated surfaces is subject to:

1. The nature of the lubricating oil used.
2. The temperature at which it is applied and used.
3. The changes which it undergoes; be they mechanical or chemical.
4. The changes and conditions to which the lubricated surfaces are subjected to while in use.

In a properly lubricated machinery, say for instance, the journals of a shafting rolling in their stationary bearings, the lubricating oil forms a liquid cushion between the rubbing metallic parts; some of the oil adheres to the stationary bearings and some of it is forced along in the direction of and with the moving shafting; again the moving shafting is cushioned with the same lubricating oil, part of it adhering to the shafting and part of it moving along in the same direction and with the same velocity of the shafting. We have, therefore, external as well as internal friction. The friction of lubricated surfaces is subject to the internal friction of the lubricating oil—its cohesion or viscosity—and the friction of the rubbing surfaces.

Now if we add pressure to the lubricated surfaces, the general rule will be, the larger the pressure the larger the friction., though we also have some variations at smallest and largest pressure, and because the lubricating oils do not change their density in the ratio of the increased pressure, and the increase of their internal friction is small. The Friction does not increase in the same ratio of the pressure, the Friction Coefficient becomes smaller.

Furthermore, the friction of lubricated surfaces is subject to the temperature and the changes of the rubbing surfaces while in motion. New bearings will cause more friction than older, polished ones. The friction between bodies of the same substance is larger than that of different substances. The machinist knows this and constructs the one part of the rubbing surfaces of steel, the other of a softer metal, iron, babbitt, etc.

We distinguish two kinds of friction, the sliding and the rolling friction. Friction is produced mostly between solid bodies, there is some produced also between liquid and gaseous bodies, or if they come in contact with solid bodies. As the cohesion in liquid bodies is much smaller than in solid bodies, and still smaller in gaseous bodies, which have no cohesion, it is evident that the friction produced by these bodies is diminishing and smallest in gaseous bodies.

Friction is also defined as the resistance caused by bodies coming in contact under pressure and with different velocities.

Friction is the converting of force into heat.

By the application of lubricating oils we are trying to overcome the obstructions, the resistance, opposing the free motion of the moving parts of different bodies coming in contact, and we call these obstructions—Friction. How far the friction is reduced by the lubricating oil is determined either directly from the friction coefficient or indirectly by taking the raise of temperature of a journal lubricated with the oil under consideration and running a certain number of revolutions under a certain pressure. The Henderson-Thurston apparatus is of simple and practical construction, it permits to raise or lower the pressure to actual conditions.

The internal friction of lubricating oils is of great importance and corresponds to the "viscocity" or the "body" of the oils. For some purposes—for instance under heavy pressure and great velocity, it is necessary to apply a viscous or cohesive oil, at the same time the higher internal friction of this oil is objectionable and can be reduced greatly by the addition of a certain percentage of an oil with less internal friction, otherwise conforming to the specifications stipulated for the purpose. Such "compounded" lubricating oils are, for instance, the heavy viscous "Mineral Cylinder" and "Valve" oils with the admixture of small percentages of highly refined, neutral, non-drying vegetable and animal oils, like Olive, Rape, Colza, Neatsfoot, Tallow Oil, etc. By this admixture the viscous Mineral Lubricating oils still keep their body, their strength to carry heavy loads or to work under heavy pressure, at the same time they become "sprayable," i. e., they can be "atomized" with steam into a fine spray, causing the oil to form a thin film or coating over the parts of the machinery to be lubricated. They also show in the sight-feed lubricators a smaller drop than the straight, non-compounded heavy Mineral Lubricating Oils.

Internal friction of lubricating oils is increased by the presence of gums, resins, mineral bodies, mineral acids, alkalis, tar, soaps, water, fatty acids, and such bodies may also seriously affect the metallic parts of journals and bearings.

Water, though not considered a lubricating oil, is, on account of its great cooling or heat absorbing properties, and its elasticity and fluidity, a fine agent to reduce or prevent friction. I bring to mind the old mill wheel and the modern turbine wheel. The parts immersed in water require no other lubrication. Also I call your attention to a very ingenious application of water to prevent friction in the "rifled" pipe lines of California. These lines have been constructed for the carrying of very viscous, gummy, heavy Crude-petroleum. It was found that this oil in ordinary lines caused such friction-resistance that it could not be pumped at all. By "rifling" the lines on the inside (like a musket) and pumping with the Crude oil at the same time a stream of water into these pipe lines, the following effective result is obtained. The water forms a layer next to the iron pipe, thereby preventing the oil from touching the iron, and the oil is easily forced through the center, sliding with little friction over the water. The water being kept in motion in the same direction with the oil helps to carry it from station to station. The rifling accelerates the motion and divides the pressure over the area of the pipe.

A good lubricating oil must adhere tenaciously to the rubbing surfaces; it must form a liquid cushion between these surfaces; it must withstand and not become displaced by any pressure, blow or shaking motion; it must not lose by evaporation, either at ordinary temperature or at the highest temperature it may be exposed to while in use; furthermore, it must not become chemically changed while in use, neither by oxidation nor by gumming. It must combine highest possible fluidity with greatest adhesion. Good lubricating oils must keep their state of fluidity as nearly as possible the same, within reasonable changes of temperature.

In the lubricating of machinery the old rule "one ounce of prevention is worth a pound of cure" is most successfully applied. A large modern power house (take those of the Niagara Power Co. at Niagara Falls as a standard) employs this simple rule with the best economical results. All the bearings of the ponderous 5,000 H. P. generators with their steel shafts going down to the bottom of the falls, a distance of 200 feet, are continuously flooded with lubricating oil. Through a pipe system of many miles in length the clean lubricating oil flows from the storage tanks to and around the bearings, it prevents friction, absorbs what heat there is formed, flows to the regenerating tanks, where it is washed with hot water and separated from water and dirt, and it finally goes back to the storage tanks and is ready to flow again to the bearings. This is an economic, continuous lubricating process and the loss is very small, almost entirely accidental. A pure Mineral Lubricating Oil, made by the Eclipse Works at Franklin, Pa., is used.

Uniformity of consistence at varying temperatures is a most desirable attribute of a good lubricating oil. Mineral Lubricating Oils have to-day almost entirely taken the place of Vegetable and Animal Lubricating Oils. From practical experience we have found, and are verifying it with chemical research work, that carefully concentrated Mineral Lubricating Oils taken out of the Paraffine and Olefine series of Hydrocarbons, give the most satisfactory results. These are the Hydrocarbons contained in the Crude Petroleum, which we still have around us here in the good, old Pennsylvania Oil Country. They are prepared by, and shipped to all parts of the world for lubricating a large slice of the entire globe, from the plants of the Eclipse Lubricating Oil Works and Galena-Signal Oil Co. at Franklin, Pa.

Testing Lubricating Oils.

We shall now give Lubricating Oils a *critical examination* based on their physical and chemical properties and describe some of the best methods for testing them, leaving out the description of the apparatus required, which can be found in many good illustrated books on the subject; i. e., Holde, Untersuchungen der Mineral Oele and Fette; Kunkler, Maschienenschmierung; Gill, Oil Analysis; Lewkowitsch, Technologie der Oele; Hefter, Technologie der Oele; Allen, Commercial Organic Analysis, and others.

1. *Gravity:* All fatty oils, animal and vegetable oils, are distinct bodies of unvarying chemical constitution; therefore their specific gravities never change. Mineral Lubricating Oils are made from Crude Petroleum, and vary greatly in specific gravity, according to the nature and origin of the Crude, the different Hydrocarbon series represented in them, the process used in their manufacture, and the purpose for which they are made. The gravity test is important and is taken either with the Picnometer, the Westphal balance, or the Baume Hydrometer.

2. *Color, Fluorescence (bloom) and Odor:* The color of Lubricating Oils varies from water white to black. The color is a true indicator of the degree of purity of the oils. All absolutely pure, fatty oils and Hydrocarbons are colorless. Therefore, all color in the oils indicates the presence of impurities. For many economical reasons it is not necessary nor advisable to produce "chemically pure" oils, the principal reason being the enormous expense connected with such a procedure. It has been found satisfactory to furnish the Lubricating Oils to the consumer according to the purpose for which the oil is to be used and in accordance with certain established "standard" colors. There are several "colorimeters" in use for detecting small differences in color.

The Fluorescence is most pronounced in Mineral Lubricating Oils. It is a characteristic property of many Hydrocarbon Oils to refract the rays of light and according to the angle under which you look at a bottle filled with such oil, it may appear to you either opaque, green or blue, or transparent, light-colored or colorless. The Flourescence can be best noticed by placing a drop of oil on black glass or other dark substances. The Fluorescence of Mineral Oils is not inherent to the pure Hydrocarbons, therefore it can be removed. It is caused by the presence of minute quantities of Hydrocarbons of the aromatic series. By Oxidation and other severe chemical treatment those aromatic Hydrocarbons can be removed. It is also possible to cover the Fluorescence, or bloom, of the oils by so-called "Anti-fluorescents" like Nitro-benzol, Nitro-naphthaline, etc.

The odor of Lubricating Oils varies greatly from odorless to the many characteristic odors of all the animal and vegetable oils.

3. *Flash Point* of a Lubricating Oil is the temperature at which an oil gives off vapors forming an explosive mix with air.

4. *Fire Test* is the temperature at which the oil gives off vapors which, when ignited, will burn continuously.

Flash and Fire Tests are very important. They guarantee the points at which a lubricating oil can be used with safety. For instance, if you would lubricate a steam cylinder with light Engine Oil of 300° F. flash, what would be the consequences? The oil would evaporate in the steam cylinder, create extra pressure and be liable to cause an explosion. In a well prepared Lubricating Oil the Fire Test is from 50 to 75° F. above the Flash Test. There are many different Flash and Fire test instruments in use.

5. *Cold Tests* of Lubricating Oils are very important to be known. It is self-evident that an oil which is very stiff or solid at Zero temperature cannot be used for lubricating a gas engine working in an atmosphere kept at this temperature. All animal, vegetable and mineral lubricating oils (with the exception of certain natural lubricating oils, such as Franklin First Sand Oil, etc.) contain solidifying fats, or Paraffine or Spermaceti. These legitimate constituents of the natural Crude Oils, from which the lubricating oils are made, will congeal or become crystallized at certain low temperatures. We call the initial point at which these solidifying bodies show their presence in the lubricating oils the *Cloud Test* and the *final* point—at which the whole mass of the oil either becomes solid, or, after being solidified, just turns back again into the liquid state,—we call the Pour Test or Solidifying Point. This is the principle underlying several methods for taking Cold Tests used by the manufacturers and large consumers of Lubricating Oils.

6. *Viscosity:* Cohesion and internal friction of a lubricating oil are identical, as we have stated before. We know the "ideal" lubricating oil is the one with infinite adhesion and no cohesion. In practical use that lubricating oil gives the best results which is the most fluid oil that will stay in place while in use; therefore, the degree of fluidity of a lubricating oil, its Cohesion or Viscosity, allows us to judge its value as a lubricant, by comparing it with the Viscosity of lubricating oils, recognized and proved to be best suited for certain practical work. But we must be cautious in applying this rule, as it refers only to oils of the same origin and nature. We cannot compare directly the Viscosity of an animal or vegetable oil with that of a Mineral Oil. Even by comparing the lubricating values of Mineral Oils, the Viscosity tests alone would not be sufficient to decide which is the better lubricant. The origin, nature, chemical composition of a Pennsylvania Crude Petroleum differ greatly from Crudes produced in Texas, California, Russia, etc. Many Viscosimeters are in use. The Saybolt, Tagliabue, Engler, Redwood, Penn'a R. R. instruments are Pipette-Viscosimeters. They measure the degree of fluidity of an oil, by letting a certain volume of oil at a specified temperature flow through a standardized orifice and calling the time, in seconds required to do this, the Viscosity. Other instruments, like the Doolittle and Napier, are Torsion Viscosimeters. They show the degree of retardation of a metallic cylinder rotating in the lubricating oil at specified temperature.

7. Presence of *moisture* or *water* in lubricating oils is undesir-

able. It is liable to cause changes by oxidation; by converting into steam at a raised temperature, it is liable to produce pressure; to bright, sparkling oils a little moisture will give a sad, cloudy or milky, emulsified appearance. It is possible to make an emulsion of the appearance and consistency of white cheese from oil and water. Moisture (water) can be removed from oils by drying or "distilling" methods, or with the help of driers and absorbents, such as salts, clay, chloride of calcium, plaster of Paris, etc.

8. *Acidity* of lubricating oils is always detrimental and must be carefully avoided. We may have to look for mineral acids, as well as organic acids, such as sulphuric and sulphonic acids, fatty and "Naphthene" acids. The mineral acids usually can be extracted with water and determined, for instance in the case of sulphuric acid, with Chloride of Barium. The organic acids are dissolved in alcohol or alcohol-ether and titrated with standard alkali solutions, using Phenol-Phtaleine for indicator.

9. *Sediment* of a slimy, organic nature may be found in animal and vegetable oils whenever they are not properly refined. Insoluble mineralic bodies, such as sand, dust, salts, etc., may show their presence by forming sediments or crusts. They can be determined by filtering certain quantities of the oils, washing the insolubles with benzine and drying the residuum. Soluble mineralic bodies are sometimes added to give lubricating oils for certain purposes an exceptional heavy body. The "stearates," "oleates," "palmitates" and "resinates" of Calcium and Aluminum are used for this purpose. In such a case and in order to determine the nature and percentage of these bodies, we will have to proceed about as follows: We find a solvent to separate the oil from the fatty salts. The fatty salts we separate into fatty acids and mineralic basis, with the help of a strong mineral acid; then we analyze each separated part by itself. Such an analysis is sometimes a very complicated affair.

10. *Action of Sulphuric Acid.* Strong Sulphuric Acid does not affect pure Hydrocarbons of the Paraffine series and very little those of the Olefine series. It affects strongly animal and vegetable oils and many valuable combinations may be obtained by this action, for instance at low temperature the converting of Castor Oil into Sulpho Acids, so-called "Soluble Oil." Furthermore, we have the Maumene test and specific temperature action, based on the raise of temperature, caused by mixing an oil at specified low temperature with Sulphuric Acid of 1.845 specific gravity. With these tests we can distinguish many oils. At a raised temperature strong Sulphuric Acid destroys, burns all animal and vegetable oils.

11. *Gum and Gumming.* Gum, such as Asphaltum, etc., is not a lubricant, it causes friction, it should not be present in lubricating oils. As it is insoluble in very light Gasoline (88° Be, or lighter) also in a mix of one part alcohol 96% and two parts of Ethyl-Ether, we have a way of separating the Asphaltum from the oils with these solvents. The gumming of a lubricating oil is usually caused by the absorption of oxygen from the air. It is

an oxidation, a chemical process, by which free acids are formed and these acids are affecting chemically the metallic surfaces, causing corrosion, forming crusts or deposits, whereby friction is increased. Mineral lubricating oils show little or no tendency to gum or to become affected by oxidation, and this is one of the reasons of their displacing animal and vegetable oils for lubricating purposes.

12. *Sulphur* in lubricating oils is also liable to cause chemical changes by acting on the metallic surfaces and in this way causing friction. Sulphur is detected by heating the oil to boiling point with a bright piece of metallic Potassium or Sodium, when it will form yellow Sulphide of Potassium or Sodium, or by immersing a bright silver coin into the warmed oil, or letting the oil stand in a polished copper dish, when the sulphur will form black Sulphides with the metals. The sulphur-determination is made by burning a weighed quantity of the oil in a lamp under a glass funnel. The combustion gases formed by the flame contain the sulphur as Sulphuric acid, they are drawn through Standard Soda Solution, and after burning sufficient oil, the Soda Solution is titrated with Standard Acid Solution, using Methyl-Orange for indicator and so the exact quantity of acid is found, which is made from the sulphur in the burned oil. By simple figures we are able to convert this acid back into Sulphur and its percentage in the oil.

13. *The Elaidin Test* is based on the change of the liquid Olein into the solid, isomere Elaidin, under the influence of Nitrous Acid. This is a very valuable test to distinguish some vegetable oils.

14. *The Saponification-value* of an oil expresses the milligrams of hydrated Potassium Oxide, which are required to saponify one gram of oil. The test is made by saponifying a small quantity of oil with Standard alcoholic Potash solution at boiling temperature on return condenser. Finally the excess of Potash is titrated with Standard Hydrochloric or Sulphuric Acid, using Phenol-Phtaleine for indicator. Each pure oil has an established unvarying Saponification value, therefore this value is "constant."

15. *Iodine-value* refers to the percentage of Iodine absorbed by an oil. For instance, we have a number of series of fatty acids on which Iodine acts differently. The Stearic Acid series consists of stable bodies, oxidized saturated Hydrocarbons, Iodine does not combine with these saturated acids. The Oleic Acid series consists of oxidized unsaturated Hydrocarbons, and so does the Linoleic series. The unsaturated fatty acids of the Oleic and Linoleic series are able to absorb Iodine in the same ratio as they are unsaturated and by this action give us the means to divide quantitatively the unsaturated from the saturated fatty acids. The test is as follows: a weighed quantity of oil is dissolved in chloroform, sufficient Iodine, dissolved in 96% alcohol, is added and also some Chloride of Mercury (which acts as a regulator of the Iodine absorption). After standing from 1 to 1½ hours and adding some starch solution for indicator, this mixture is titrated with Standard Sodium Hypo-sulphite Solution, of which each CC is equiva-

lent to .0127 Iodine. The percentages of Iodine determined in this way are "constant" for the various pure oils. Also the unsaturated Hydrocarbons of the Olefine series can be distinguished from the saturated Hydrocarbons of the Paraffine series with the same Iodine absorption test.

16. *Volatility Test* of lubricating oils taken at 212° F., 325° F. and 400° F. is important and shows us the percentages of loss by evaporation while in use at raised temperatures.

17. *Free Carbon Test* is becoming of importance, as it shows the stability of a lubricating oil at high temperatures; i. e., in internal combustion-cylinders of autos, gas engines, etc. The test is made to show how much lubricating oil is carbonized under extreme conditions.

While there are a number of tests in use, we want to describe only our "Franklin Test," which is as follows:

Two ounce beaker is filled one-half with the oil to be tested; place beaker in a shallow sand bath over bunsen burner; suspend bulb of high fire test thermometer over the center of oil, immersing it into its surface. Heat up to 600° F. in ½ hour; hold temperature 600° for ½ hour; then turn off the burner and let oil cool to ordinary temperature. Of this oil take 10 cc and mix with 190 cc 88° Gasoline in 200 cc graduate (stoppered). Filter this Gasoline solution at once through one folded filter 23 c.m. diameter (No. 3226 catalogue Eimer & Amend). After this solution is filtered, wash the filter carefully with 100 cc 88° gasoline. Then wet the residuum on filter with 25 cc Chloroform. Finally wash filter with 100 cc 88° Gasoline.

Let filter with carbon deposit dry on air and submit it for inspection, properly labelled. By comparing the filters with carbon deposits from different oils, a very fair estimate of the presence and quantity of carbon is obtained.

There are several other valuable tests to be mentioned here, for instance, the Acetyl-number and the Hehner-number, which give the percentages of insoluble fatty acids and unsaponifiable matter present.

The Calorimetric and Photometric tests of lubricating oils do not give us much information about the nature of these oils, while the solubility tests in Alcohol, Acetic Acid and other solvents are sometimes helpful. For instance, by this means we can distinguish a number of bituminous bodies contained in Asphaltums. We have the Asphaltenes, soluble in Tetra-Chloride of Carbon, and the Carbenes not soluble in Tetra-Chloride, but soluble in Bisulphide of Carbon.

Then we must mention the Refraction indications of the lubricating oils obtained in the Refractometer, and the optical Rotation numbers in the Sacharimeter, and Polaristrobometer, also the microscopic and spectroscopic examination of the oils, which all give us valuable hints of the origin of the oils, their nature and composition.

The melting and solidifying points of oils, solid at ordinary temperature—the fats—and also the Paraffine Waxes, are not identical. It is customary now to take the melting and solidifying points of the free fatty acids in the fats. In taking the solidifying point of Paraffine Wax with the "Saybolt" method, we are making good use of the following characteristic action of all Paraffine Waxes: at the point when they change from the liquid into the solid, crystallized condition, the temperature remains stationary for upwards one minute.

Vegetable and Animal Oils.

Animals and some portions of plants contain oils and fats in varying quantities. Many of these oils and fats are valuable, they can be and are extracted and made use of by and for mankind. Many methods are in use to obtain these oils and fats, and the general rule prevails: for internal use—take cold pressed oils, for all other purposes take warm pressed or extracted oils and fats.

Chemically speaking there is no dividing line between these oils and fats; it is simply a matter of temperature to call the one "oil," the other "fat." Butter in our climate is solid—a fat; —in the tropics it is liquid—an oil. All animal and vegetable oils and fats, or "fatty oils," are closely related. They are called "Glycerides" because all contain the same base "Glycerine" in chemical combination with many fatty acids. They are true "salts," i. e., Stearate. Oleate, Palmitate, Linoleate, of Glycerine, etc.

Under the influence of air, moisture and heat all fatty oils become rancid, that is, the salts mentioned above, "the Glycerides," become decomposed, resulting in free Glycerine and free fatty acids. A piece of fresh, sweet butter left in the open will quickly become rancid, noticeable by strong odor caused by the volatile free fatty acids of the butter, like Formic, Acetic, Butyric, Valeric, Caproic Acids, which all have peculiar, strong odors.

All fatty oils are either of a "non-drying" or "drying" nature. Olive and Neatsfoot Oils are non-drying; Linseed and Hempseed Oils are drying; Cottonseed and Corn Oils are between both, they form gradually gummy deposits when exposed to the air in thin layer, therefore Cottonseed and Corn Oils are not fit to be used as Lubricating Oils, while the non-drying oils—Olive and Neatsfoot Oils are good Lubricating Oils. All fatty oils saponify when boiled with caustic alkali. The entire soap manufacture is based on this chemical action. While we have only one base "Glycerine" in all fatty oils, there are many fatty acids in these oils. Glycerine is a tri-basic alcohol $C_3\,H_5\begin{matrix}OH\\OH\\OH\end{matrix}$; it is a water white viscous liquid, odorless, of sweet taste, of 1.2665 specific gravity, hygroscopic, soluble in water. It is a great solvent for many substances, it boils at 290°C., it is volatile with steam, when heated with strong sulphuric acid to high temperature it becomes dehydrated. Glycerine burns with the blue alcohol flame, forming Acroleine C^3H^3OH, with its strong irritating odor, always noticeable when fatty oils are burned.

Of fatty acids we have principally to do with those of the following three series:

Stearic Acid series $C_n H_{2n} O_2$.
Oleic Acid series $C_n H_{2n-2}O_2$.
Linoleic Acid series $C_n H_{2n-4} O_2$.

The first members of these three series are liquid, volatile fatty acids, soluble in water; the other members are insoluble in water, soluble in alcohol, ether, essential and Hydrocarbon oils. The higher constituted ones of the Stearic Acid series are solid-like Stearic Acid. These are "saturated" fatty acids, they do not combine with Iodine. The fatty acids of the other two series are "unsaturated." Those of the Oleic series combine with 2 atoms Iodine and those of the Linoleic series combine with 4. The saturated acids of the Stearic Acid series are related to the Paraffine series of Hydro carbons and can be prepared from them. The unsaturated acids of the Oleic Acid series are liquid, they correspond and are related to the Olefine series of Hydrocarbons, and can be prepared from them. Nearly all of the acids of the Oleic series can be converted into isomeric, solid acids by the action of Nitrous Acid. This action is called "elaidinizing." Liquid Oleic Acid is isomere with solid Elaidin. Acid. Both have the same formula $C^{18} H^{34} O^2$, but they differ in their properties, actions, etc. The unsaturated acids of the Linoleic series are liquid, they are contained in the drying oils, like Linseed and Hempseed Oils. They will "elaidinize" with Nitrous Acid.

Sulphuric Acid combines chemically at low temperature with many of these fatty acids, converting them into soluble Sulpho-acids. At higher temperature—above 60° F.—the fatty acids are burned, destroyed by strong sulphuric acid. All fatty acids burn with more or less smoking flames when lighted. Some of the solid saturated acids of the Stearic series, like Stearic Acid, after a careful refining process and separation from the other fatty acids, can be burned smokeless with a wick and for this reason are used in candles (Stearic Acid candles).

The unsaturated fatty acids and the fatty oils, when burned with a wick burn with a dull, smoking flame, smearing over the wick, sometimes extinguishing the flame. This is caused by the forming of soft soaps, the fatty acids combining with the Potash in the ashes of the burned wick; also, these acids and fatty oils, not being of a uniform nature, feed the flame irregularly, and as they become heated the supply is greater than the consumption, causing an overflow of the melted fats of low melting points.

In former years we had to depend on fatty oils for all lubricating purposes. To-day the Mineral Lubricating Oils, the non-oxidizable Hydrocarbon oils, have displaced them almost entirely. As we have stated under "Internal friction," for some special purposes neutral, fatty, non-drying oils are used for lubricating purposes, especially in compounding with viscous Mineral Lubricating Oils. In this combination they may be very desirable, in so far as the fatty oils help to loosen the cohesive properties of the Mineral Lubricating Oil without affecting their adhesive or lubricating properties, they may even materially increase them. Such compounded oils have these advantages: they form a smaller drop in the sight-feed lubricator; they atomize or spray easier, form a thinner film; they absorb heat, produced by friction quicker, more thoroughly; therefore they are better cooling agents. For these reasons some of the best known Valve and Cylinder Oils, Railroad Car, Coach and Engine Oils, such as "Twentieth Century," "Capitol," "Model," and "Shield" Cylinder Oils, "Perfection Valve Oil" and all Galena Oils, contain a percentage of fatty oils.

As stated before the great bulk of all Lubricating Oils to-day is made up of the Hydrocarbon, "or Petroleum" (Mineral) Lubricating Oils.

Hydrocarbon Oils.

The name Hydrocarbon stands for the two elements—Hydrogen and Carbon in chemical combination, and this gives the Hydrocarbons their most characteristic distinction from the fatty oils, which have besides Hydrogen and Carbon also Oxygen in the molecule, and may be considered as oxidized Hydrocarbons. There are a great many different groups, or series of Hydrocarbons. According to the general chemical formula, which belongs to each series, we have, for instance, the

Paraffine series .....$C_n H_{2n+2}$
Olefine series ....$C_n H_{2n}$
Acetylene series.....$C_n H_{2n-2}$
Terpene series ......$C_n H_{2n-4}$
Aromatic series......$C_n H_{2n-6}$ etc., ending with the
Chrysene series .....$C_n H_{2n-24}$

Of all these series we need to consider here only, or principally, two or three, the Paraffine, Olefine and Naphthene series; the last named is an isomeric series of the Olefines; both have the same general formula $C_n H_{2n}$.

Our Pennsylvania Crude Petroleum is the finest representative of the Hydrocarbons of the Paraffine and Olefine series. The Paraffine series, $C_n H_{2n+2}$ is also named Methane series, from its first and simplest representative CH_4, which is a gaseous Hydrocarbon and well known under the name—Marsh Gas. By the addition of CH_2 to the formula CH_4 we obtain the second member of this series—Ethane C_2H_6, etc. The first members are gaseous, the higher ones liquid, and the highest members with 24 or more atoms of Carbon in the molecule, are solid, the so-called Paraffine Waxes.

The Paraffine series contains the most stable Hydrocarbons, best suited for lubricating purposes. They are saturated Hydrocarbons, not affected by strong chemicals and the name—Paraffine

(Parum-affinis) "little affinity" refers to the stability and unchangeableness of these bodies. Iodine does not combine with Paraffines.

The Olefine series Cn H2n contains unsaturated Hydrocarbons. They are somewhat affected by strong chemicals and absorb Iodine, which gives us a means to ascertain their presence. The Olefines are liquid Hydrocarbons and form with the liquid Paraffines the entire mass of our Penn'a Mineral Lubricating Oils. These Lubricating Oils either contain some of the solid saturated Hydrocarbons of the Paraffine series, the Paraffine Waxes, or they are free from them. The less Wax they contain the better cold tests they have. Paraffine Wax is not a lubricant. We have some natural cold test Lubricating Oils in Pennsylvania —the Franklin First Sand Oils. These oils are liquid at 15° below Zero. They do not contain Paraffine Wax. The Galena-Signal Oil Company uses nearly all of these oils in some of their Galena Coach Oil, etc.

We are also able to remove the Paraffine Wax from the Paraffine-Olefine mix of Hydrocarbons in the same way as the manufacturer of fatty oils removes the solid Stearine, Palmitine, etc., from the liquid Oleine, by chilling and pressing at low temperatures. For instance, the well known 20th Century Oil, mentioned before, (manufactured by the Eclipse Oil Works) is freed from Paraffine Wax in this way.

While, as a rule, the higher members of all series of Hydrocarbons increase in density or specific gravity in the ratio of the increased number of atoms of Carbon and Hydrogen in the molecule, the solid members of the Paraffine series, the Paraffine waxes, make a distinct exception from this rule, inasmuch as they are much lighter in gravity than the accompanying liquid Paraffine and Olefine Hydrocarbons of the same composition and general formula. The Paraffine Waxes are present in the Crude Petroleum in an amorphous or "colloidal" form. This form changes when the Crude Petroleum is exposed to high temperatures and the different grades of Paraffine Wax thus obtained are of a "Crystalline" nature when we remove them from their liquid associates. The Paraffine Waxes crystallize in transparent scales, like fish scales, and the name "Paraffine scale" refers to this peculiar form of crystals.

The Mineral Lubricating Oils can be burned smokeless in special lamps. The combustion gases formed are Carbon-dioxide and steam. No irritating products are formed. When burned in an open lamp, without specially increased air supply, chimney, etc., these oils give smoky flames, because some of the Carbon is not consumed but is expelled in form of soot or free carbon, wasted. Here again the solid Paraffine Hydrocarbons, the Paraffine Waxes, show their different nature from the liquid Hydrocarbons insofar as the pure ParaffineWaxes burn smokeless in an open lamp, and because of this characteristic peculiarity we use Paraffine Waxes for smokeless burning candles, also as Miners Sunshine in the regular miners' lamps. These Paraffine

Waxes do not only burn with a smokeless flame but the flame is of a whiter color—it has a higher candle power—than the flame of the corresponding liquid Hydrocarbons and the fatty oils.

The Hydrocarbons are not affected by caustic alkali, they do not form "soaps."

The Olefines, being unsaturated, can be converted into alcohols and acids; they are more chemically active than the Paraffines.

The third series of Hydrocarbons mentioned, the Naphthenes, are not found in our Penn'a. Crude Petroleum. They are contained in Russian and other Crudes. Their general formula is $C_n H_{2n}$. They are isomere with the Olefines, unsaturated. They can be converted into the aromatic series of Hydrocarbons, and are usually contaminated with them. The specific gravity of the Naphthenes is relatively greater than that of the Olefines and Paraffines. They are more viscous and their boiling points are lower. This explains why Russian Lubricating Oils have lower flash and fire tests than Pennsylvania Oils of the same gravity. Strong acids have a strong action on the Naphthenes.

If we exclude the natural Mineral Lubricating Oils, like Franklin First Sand Oils, then the statement holds good that all Mineral Lubricating Oils are manufactured from the various grades of Crude Petroleum found in all parts of the globe. The word "Petroleum" is derived from "Petra"- rock; and "Oleum"- oil, therefore Rock-oil. Petroleum is known as far back as history reaches. It is mentioned in the Bible. But only since Colonel Drake "struck oil" in 1859 at Titusville, Pa., has the Mineral Oil industry been developed. In the infancy of the Pennsylvania Mineral Oil industry little attention was paid to the valuable heavy parts of the Crude—the Lubricating Oils and Waxes. Each refinery was simply striving to obtain the largest possible yields of marketable lamp or "kerosene" oils. The refiner knows now that by applying high temperature, or a destructive distillation, "the cracking process" he increases his yields of light Distillates, such as Kerosene, etc., oils and at the cost of the heavy, viscous parts of the Crude, the parts which contain the lubricating oils, the most valuable assets of our Pennsylvania Crude Petroleum.

By the "cracking" of the Hydrocarbons of the Pennsylvania Crude we loosen the molecules; we might call it the splitting up of dense molecules containing many Carbon and Hydrogen atoms, into several light molecules, with less Carbon and Hydrogen atoms. There is a loud "cracking" noise to be heard in the stills where such a cracking process is going on. The noise is caused by the formation of water vapor, as one of the products of this destructive process, and the water vapor at the high temperature at which it is formed seeks an instantaneous outlet and separates from the oils quickly and very noisily. There is free Carbon—coke—formed in the cracking process, besides a number of light oxidized distillates. So while at first one might think this would be a fine process for making out of one barrel of Crude two barrels, or at least more than one barrel, Kerosene Oil etc., in reality it is not quite such a remunerative procedure. The worst feature of the cracking process is the loss of the high standards of quality for all products made with it.

The theory which explains the high quality of the "ideal" Pennsylvania Lubricating Oils is partly based on the assumption that the molecules forming the Crude Petroleum are present in the shape of perfect globules or balls. It is the rolling ball which causes the least internal and external friction; it exposes the smallest surface to the load or pressure resting on it, and therefore it resists its crushing, flattening effort better than any other geometric figure we have. Since understanding and adopting this globule theory the so-called ball-bearing journals have been successfully introduced for many purposes. The globule theory underlies the manufacture of Lubricating Oils from Penn'a. Crude Petroleum.

We are living in the age of "Conservation." We know we cannot improve perfection. A perfect round ball is the standard given us in the Crude and we are trying to keep—to conserve its shape—and to free it from adhering impurities.

A severe destructive process, such as the cracking process, is 'a priori' out of the question for making Lubricating Oils. At best we obtain with such a process an increased yield of inferior distillates. The "cracking" man is striving to distill—to drive over the goose-neck—as much of the Crude as possible. The "concentrating" or "lubricating" man is trying to conserve all the heavy parts, the lubricating stocks of the Crude; he knows that excess of heat will "roughen" the globules or balls in the Crude; he knows that Petroleum Hydrocarbons carry very little latent heat, are not very elastic, and he has found that steam is his best assistant to carry on his conservation process; with the steam constantly bubbling through the concentrating lubricating stocks in the still, he keeps "the balls a-rolling" all the time, and protects them against super-heating and cracking, while at the same time the elastic steam-vapors, with the wonderful energy stored, made latent in them, carry off from the top of the lubricating stocks the light Hydrocarbons, lifting them over the goose-neck to the condenser, where they become liquified again and flow on to the tailhouse and storage tanks.

It can be readily seen that this concentrating process gives us a practical way to reduce the lubricating stocks to any consistency within reasonable limits. Some of the lighter grades of the lubricating oils are carried over with the steam and separated. They are refined and prepared for lubricating light and fast running machinery. Various methods, suited for each purpose, have to be used in their preparation. The constantly increasing and broadening fields for lubricating oils, the new fields for improved machinery—all depending on the right quality of lubricating oil to move them—keep the manufacturer of lubricating oils on the alert all the time and in close touch with the mechanical engineer and machinist.

All pure Hydrocarbons are colorless, therefore, chemically pure mineral lubricating oils are of water-white color. While this is a theoretical axiom, and holds good under all conditions for obtaining the highest quality and efficiency of all Hydrocarbons, practically to come up to this standard would involve a great expense, a big loss of material, and would not be necessary in most cases. We are able to remove the impurities from the mineral lubricating oils in many ways. Strong chemicals (such as sulphuric acid) we have heard before, do not affect the pure Paraffine Hydrocarbons, and very little the pure Olefines. On the other hand, this acid scorches, burns, removes some of the impurities accompanying these Hydrocarbons. Also strong Alkalis remove some of the impurities, and likewise Bichromates, Chloride of Lime and other chemicals.

Furthermore, we have many filtering substances, which have great affinity for the color-giving impurities of the mineral lubricating oils, and for this reason are much used. Such filtering materials are, i. e., Bone Black—animal "charcoal" or "carbon"; Clays of different localities—"Fullers" and "Infusorial" Earth.

The mineral lubricating oil manufacturer does not claim to improve the Hydrocarbons, which are given to him, ready made, in a high state of perfection in the Penn'a Crude Petroleum. What he claims and tries to accomplish is to separate and purify the Hydrocarbons in such a way as to conserve their physical and chemical properties, and to give them to the consumer in such a state of purification, as will enable him to obtain the highest possible lubricating efficiency for his purpose. This may require either straight Mineral Lubricating Oils or Compounded Oils. For instance, steam cylinders working with wet steam, such as are in general use in the United States, require a lubricating oil of the following general specifications: it must have a fire test of at least 600° F.; it must atomize and spray well with wet steam; therefore it needs to be a compound of 90 to 95% mineral lubricating oil and 5 to 10% of a neutral animal or vegetable oil, such as acidless Tallow, Prime Lard, Rapeseed oil, etc. It must have a viscosity of 125 or better at 212° F. It must be free from gum, acid, tar, moisture and mineralic or other sediments. Oils like 20th Century, Capitol, Matchless, Shield, Cylinder Oils and Perfection Valve Oil give best satisfaction.

In Germany where higher efficiency of steam cylinders is obtained by the use of super-heated steam, the requirements for lubricating a steam cylinder are different. They stipulate the entire absence of any fatty oil. It must be pure mineral lubricating oil of 680° to 700° F. fire test, and a viscosity of 250 or better at 212° F. It must be free from gum, acid, tar, mineralic matter and moisture.

For the valves of an air compressor, which become heated to 500° F. and higher, it is best to use a pure mineral lubricating oil of 650° F. fire test and a viscosity of 200 at 212° F. For an upright Curtis Turbine, in which the temperature of the lubricating oil is kept at 150° to 180° F., and for a horizontal Parson Turbine, through which the lubricating oil is forced continuously at a high pressure, we find best suited a pale colored Spindle oil of 450° F. fire test and 150 viscosity at 100°. Such an oil does not carbonize, and separates quickly from admixed water in the filters.

For a centrifugal machine, say a cream separator, running at 3 or 4,000 revolutions per minute, we need a mineral lubricating oil of 400° F. fire test and 85 viscosity at 100° F. and of pale color, etc.

In conclusion we might again repeat the statement:—The ideal Lubricant's adhesive qualities are infinite and its cohesive qualities are nil. This axiomatic definition or self-evident truth, a priori, admits only liquid lubricants—Lubricating Oils—and excludes all solid, erroneously called, lubricants, such as mica, soapstone, talcum, plumbago or graphite, from the list of true lubricants. Why? Because this simple fact of their state of being "solids" proves that the cohesion of their molecules far exceeds their adhesion; they are lacking the essential feature of a true lubricant, viz.; the movability of its molecules, the rolling balls or globules.

Therefore, the first condition of a true lubricant is that it must be in the liquid state when at work. There are many solid lubricants used with perfect satisfaction, and great economy, such as greases of all descriptions, but these are all prepared in such a way and for the purpose, that when applied they melt by friction heat, they become liquified, or are converted into lubricating oils. If these solid lubricants or greases contain solids, such as we have mentioned before, they are added for the purpose of filling out loose bearings, or imperfections in the finish of the metallic rubbing surfaces, or to retard the feeding, and hold the melted greases—the lubricating oils—to the sliding or rolling surfaces.

The truer the finish or polish, if you please, of perfect fitting sliding or rolling metallic parts of machinery, the thinner we may apply the film of Lubricating Oil, the nearer we may approach the ideal lubricant—"all adhesion, no cohesion."

Therefore, theory and practice, school and shop, lubricating oil manufacturer and mechanical engineer, must work hand in hand for highest efficiency, for the least friction.

Discussion.

MR. WEYMOUTH.—What is meant by the carbon contents of lubricating oils? As I understand it, the refiners claim to be able to extract the carbon from them, but inasmuch as the carbon is present in combination with hydrogen in the form of hydrocarbons which constitute the elements of which the oils is composed, I cannot understand how the carbon can be extracted.

DR. MANN.—Of course you understand that in the lubricating oils, the carbon exists in chemical combination with hydrogen in varying quantities according to the formulae of the hydro carbon series present. The free carbon question seems to be a vital one in connection with the lubrication of internal combustion cylinders. By "free carbon" we understand that certain hydro carbons, at a raised temperature, split off some carbon, that is, they become decomposed. Some of the hydrogen is oxidized into steam while the carbon is deposited in the shape of coke. There are many methods in use for determining this "free carbon". When I mentioned the free carbon tests in use at present, I did not mention the Franklin method of testing and I refer to it now. Here is where the quality of the lubricating oil will speak for itself. A lubricating oil, chemically treated with sulphuric acid or other chemicals has a tendency to carbonize when raised to 600° Fahrenheit temperature. The quantity of carbon produced will depend upon the quality of the oil, according to the kind of hydrocarbons present. The Pennsylvania crude oil and the lubricating oils made from it, excel because in them we have stable hydrocarbons, which resist high temperatures as well as strong chemicals, better than any other hydro carbons obtainable. Refined, highly filtered Pennsylvania lubricating oils are practically free from carbon, that is, they will stand a temperature of 600° without showing any free carbon. They will become discolored only slightly. Other hydro carbons, coming from foreign countries, easily decompose, throwing off considerable free carbon, when given this test at 600° F. temperature.

MR. WEYMOUTH.—Do you find that the hydro carbons with the greater percentage of carbon relatively to the hydrogen, such as C_6H_6, deposit more carbon than lower ones, that is, that the free carbon becomes greater the farther up you go in the series? In other words, is it your aim to get rid of the higher hydrocarbons?

DR. MANN.—Yes.

MR. WEYMOUTH.—In connection with the graphite product manufactured in Niagara Falls, Deflocculated Acheson Graphite, is it possible, when using this graphite mixed with lubricating oils, to make use of a thinner grade of oil than otherwise, on the principal that the graphite will fill in the porous parts of the rubbing surfaces, and produce an artificial glaze or film?

DR. MANN.—Yes, I believe that this is the principal reason why the reports published by Professor C. F. Mabery, of Cleveland, show such an efficiency with the colloidal graphite made by Mr. Acheson.

MR. WEYMOUTH.—It is claimed that the application of the lubricant can cease for a considerable period of time before the temperature rise becomes appreciable.

DR. MANN.—Yes.

MR. JESSEN.—Pennsylvania crude oils would not be suitable for road making, would they?

DR. MANN.—We have many very heavy, viscous crude oils, like California oils, which have a specific gravity close to that of water, and, these are well suited for the making of roads, but you could not use Pennsylvania light crude for that purpose, as it requires a gummy asphaltum to make a proper combination with the broken stone, sand, etc.

Mr. Jessen.—Would any of the residuum from Pennsylvania oils be suitable for road making?

Dr. Mann.—No, for the reason that it is lacking in asphaltum. If you reduce Pennsylvania crude to the consistency of stiff tar it will stay in that same condition for an almost indefinite time. It gradually oxidizes somewhat, and may become firm during the winter, but as soon as the warm weather returns, it becomes soft and sticky. Pennsylvania oils are apparently not meant for that purpose. We have used, and still are using Pennsylvania oils for dust laying, and in this way we can do some good for roads, but for the actual building of a road it is not advisable to use Pennsylvania residuum. It is far better to use crude with an asphaltum base, such as is produced in the middle west, west and south.

Mr. Kingsland.—Does a chemical change take place, or is it a chemical combination of the asphaltum with the road?

Dr. Mann.—It is a natural tendency of the asphaltums to mix with the sand and broken stone; but although they are gradually undergoing an oxidation process and become harder on the surface, still they do not change chemically very much.

Mr. Weyouth.—You gave the specification of oils for various purposes but did not specify for gas engine oil for stationary practice.

Dr. Mann.—I would say: for this purpose the same oil which gives good satisfaction in a Parsons turbine, 150 viscosity at 100° Fahrenheit, fire test 450° and of light color, will give good results. It will not carbonize, and it will easily separate from the moisture with which it may come in contact, or, in other words, it can easily be regenerated. It will give the best results for internal combustion engines.

Mr. Weymouth.—In that case you want the oil to burn up completely?

Dr. Mann.—Yes.

Mr. Roess.—What is Trinidad Asphaltum composed of? In what way does it differ from artificial asphaltum taken from petroleum?

Dr. Mann.—It is a chemical combination of hydrocarbons, their oxides and sulphides. I cannot give the formula and do not think it has ever been established. Artificial asphalt is practically free from oxides and is more of the nature of straight hydrocarbons. There is a large field still open for investigation of the natural as well as the manufactured asphaltum. A great deal of work is going on to-day, but not very much of it is published so far. I think we will gradually obtain good distinguishing classifying and testing methods for asphaltum, but the subject is still in its infancy.

Mr. Kingsland.—Is not the deposit of carbon in an internal combustion engine sometimes due to the fuel used?

Dr. Mann.—If you have a gasoline containing heavy oil, some of the oil will carbonize, so that whatever carbon is deposited may be due to using a poor grade of gasoline, and it may also be blamed on a poor quality of lubricating oil used.

MR. KINGSLAND.—But, go further in the case of natural gas fuel, will not the gasoline in the gas produce carbon?

DR. MANN.—We have considerable gasoline, or condensible hydrocarbons, in our natural gas, and sometimes I have taken out of it pretty heavy oils. I understand there is no gasoline in Pennsylvania natural gas to-day. Heavy oils, in their crude state, are liable to carbonize.

CAPT. JAMES.—I know we find gasoline in Pennsylvania natural gas in certain sand formations.

DR. MANN.—Natural gas and gasoline are closely related. Referring to the chemical formulae of the hydrocarbons constituting Pennsylvania crude oil, the lightest ones are gases, or, in other words, they are not condensible at ordinary temperatures. You all know that to draw a dividing line between gases and liquids is practically out of the question to-day, as we can condense everything. We have liquid air and liquid hydrogen and all so-called permanent gases of former days are a thing of the past. Natural gas being composed principally of marsh gas, CH_4, the initial hydro carbon of the paraffin series, indicates a close relationship of natural gas to all the liquid hydro carbons, all belonging to the same family. Years ago I analyzed the natural gases around here and Pittsburg and always found more or less condensible liquid hydro carbons with them, either gasoline or heavier oils or both.

MR. WEYMOUTH.—I can cite one instance tending to show that some of the heavier hydro carbons are contained in natural gas. In this case, when the mixing valve of a large stationary gas engine was opened, a deposit of black oil was found, which had come in through the fuel line leading to the engine.

MR. PLATT.—One point I did not get quite clear. Did I understand you to say that the object is to completely burn up all of the cylinder oil?

DR. MANN.—It certainly should be completely burned up so as not to form any carbon.

MR. PLATT.—Should the oil not be of such high fire test that it would stay in the form of oil in the cylinder? You would not refer to oil on the piston head, but that would be left on the piston head by the explosion, and that should be consumed without any free carbon.

DR. MANN.—That is one reason why I would recommend not using oils with higher fire test than 450°.

MR. WEYMOUTH.—What is the highest possible fire test in any known oil?

DR. MANN.—We are making oils showing 700° fire test.

MR. WEYMOUTH.—My point is, that it is not possible to make an oil that can withstand the high temperatures existing in gas engine cylinders.

MR. PLATT.—The point Mr. Weymouth mentioned is no doubt true, that there is no oil of high enough test to stand the temperatures generated by the explosion. It is a question whether the walls of the cylinder ever get to such a temperature as that to which they are exposed. It would seem, if this is so, that it must be burned up after each stroke. Then you must have a different oil for each different type and size of engine, because the cylinder of a small gas engine is cooled much more than that of a large one. Also you can find engines that run a long time if you lubricate them as far as the piston has been traveling, and you would not get the little wear you do if every explosion burned off all that oil.

MR. RICHARDS.—You can run a 12″x24″ gas engine making 160 revolutions a minute with five drops a minute, and if it consumed all that, all that was carried in every time, you would soon have the cylinder cut out.

DR. MANN.—It would depend a great deal upon what you put in the cylinders. There is a long list of lubricating oils. Do not go too high in the specifying of physical tests or do not use too heavy a lubricating oil for you are then much more liable to get something that will carbonize. If you have an oil with a reasonably safe flash and fire test, like the 450° which has a flash test close to 400°, and it will be safe for the purpose, always provided that it was properly refined. Use a filtered, light colored oil. We have mentioned that it is the purity of the hydro carbons which gives you the highest efficiency. The more color there is, the more chance there is for carbonizing, of converting into solid carbon some of the impurities. It makes no difference whether these impurities are contained in the gasoline or in the lubricating oil which we have entered into the cylinder.

MR. BROWN.—In case oil is entirely consumed how is it you find signs of oil in the cylinder of an automobile or in the drip of a gas engine in the field?

DR. MANN.—It is very likely to be found there because the test which we call the vaporization test shows that some of the heavy part of the oil used has been carried off and is condensed again. You have noticed it in the exhaust steam, and whenever you do so, you have condensible oil vapors present.

MR. WEYMOUTH.—Is not that due to a great excess of oil being used?

MR. BROWN.—Would that account for it being found on the top of the piston when you take the machine down?

DR. MANN.—It could be accounted for in this way, as the result due to an excess of oil used and some of the oil becoming vaporized and condensed again.

MR. PLATT.—Suppose you have an oil that is perfectly satisfactory with natural gas, is that conclusive evidence that it would be perfectly satisfactory with gasoline?

DR. MANN.—Not necessarily, because in natural gas we have the possibilities of the fixed gas, while in gasoline everything is condensible. Gasoline is liquid at ordinary temperature, while natural gas is liable to carry a great deal of light oil vapor along with it. As you know, natural gas is allied with gasoline. Oils will act differently in contact with natural gas or gasoline.

MR. REID.—I would like to ask if you can tell from a superficial examination of the oil how it will act as indicated by the bloom? You take oil that has considerable blue color and you will find the oil nearly to the back end of the head, but it will get down into the piston pin, while other engines of the same type and size are perfectly well lubricated on the pin. Does the oil vaporize between the outside of the piston and the piston pin?

DR. MANN.—Do you mean to say that a bloom oil will be on one side of the piston and a deposit of bloom oil on the other side?

MR. REID.—Take oil that has a deep bloom and you will find the piston head well lubricated back to the compression space, but it fails to oil the piston pin through an oil pipe down to the piston pin. What happens to that oil? There is plenty on the outside of the piston head. Does the oil vaporize?

DR. MANN.—You have an oil that is too cohesive, too viscous. It does not feed through the pipe. The lighter the oil you apply within proper limits for safety, the better satisfaction you will obtain. Why do you not try to change to a lighter viscosity oil?

MR. REID.—The oil I used had less viscosity than Standard Gas Engine Oil. When you pull the piston head out you find it well oiled but the oil will not get down to the piston pin.

DR. MANN.—I do not quite see what the cause is.

MR. REID.—This oil was a light oil and the cylinder showed dry, indicating that the oil was well burnt up behind the piston head. The skin of the head was well greased but the oil did not get down through the ¼" pipe.

DR. MANN.—It may be that the oil is actually too light, that it creates vapor and that this vapor prevents feeding. It would be interesting to make a test and examination to determine the actual cause. The bloom has nothing to do with it. The bloom is caused by such infinitesimally small quantities of aromatic hydro carbons, that while you can see that they are present, the percentage is too small to have any influence. I believe that the oil actually vaporized in this case and that the vapors prevented the feeding through the ¼" hole. Otherwise the lighter oil would feed more readily than the viscous, heavier oil.

MR. WEYMOUTH.—Is there any great difference in viscosity with change of temperature between Pennsylvania oil and western oils, that is, does the viscosity not hold better in Pennsylvania oils than in the others?

DR. MANN.—Yes. It is due to the greater stability of the hydro carbons which constitute Pennsylvania crude.

THE REGULATION OF THE WIEN RIVER AT VIENNA, AUSTRIA.

By Kenneth C. Grant,* Member.

The Wien or Vienna river is a small stream rising to the westward of the City of Vienna in Austria, and flowing in a general easterly direction into the Danube canal, an arm of the Danube, leaving the river on the right bank at the upper end and entering it again at the lower end of the city. It drains an area of about 86 square miles and has a very irregular flow, being subject to frequent sudden freshets, and falling, in dry seasons, to a mere rivulet. The possible maximum discharge, upon which the design of the regulation works is based, was estimated at about 28,600 cu. ft. per second or about 330 cu. ft. per second per square mile of drainage area, but this high rate of runoff has never as yet occurred. Before the construction of the works for its regulation the river had frequently overflowed its banks, and as it passes through the heart of the city, very considerable damage had been done.

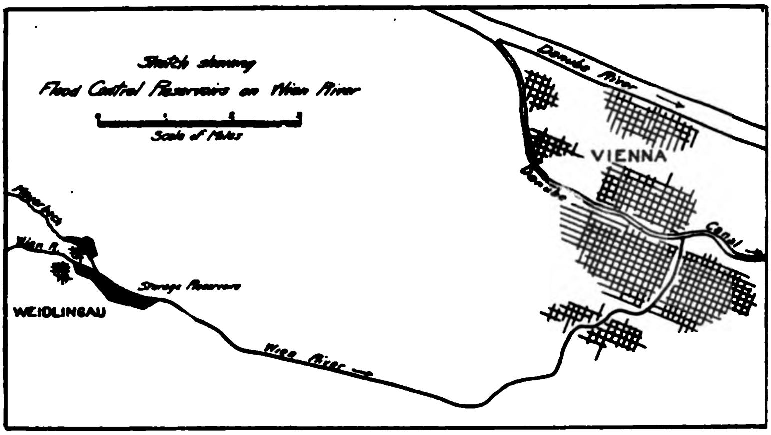

Fig. 1.

In the early nineties, studies for a method of relief from these floods were taken up by the Department of Public Works of Vienna and plans were prepared for their control and for the improvement of the channel for some distance above its mouth. This work was carried out in the years 1895-1900 and consists of the walling-up of the channel from the mouth to Weidlingau, a distance of about 10.6 miles, and of the construction of a number of small reservoirs near the head of this walled-in stretch in the villages of Weidlingau and Hadersdorf.

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*Principal Assistant Engineer, Pittsburg Flood Commission.

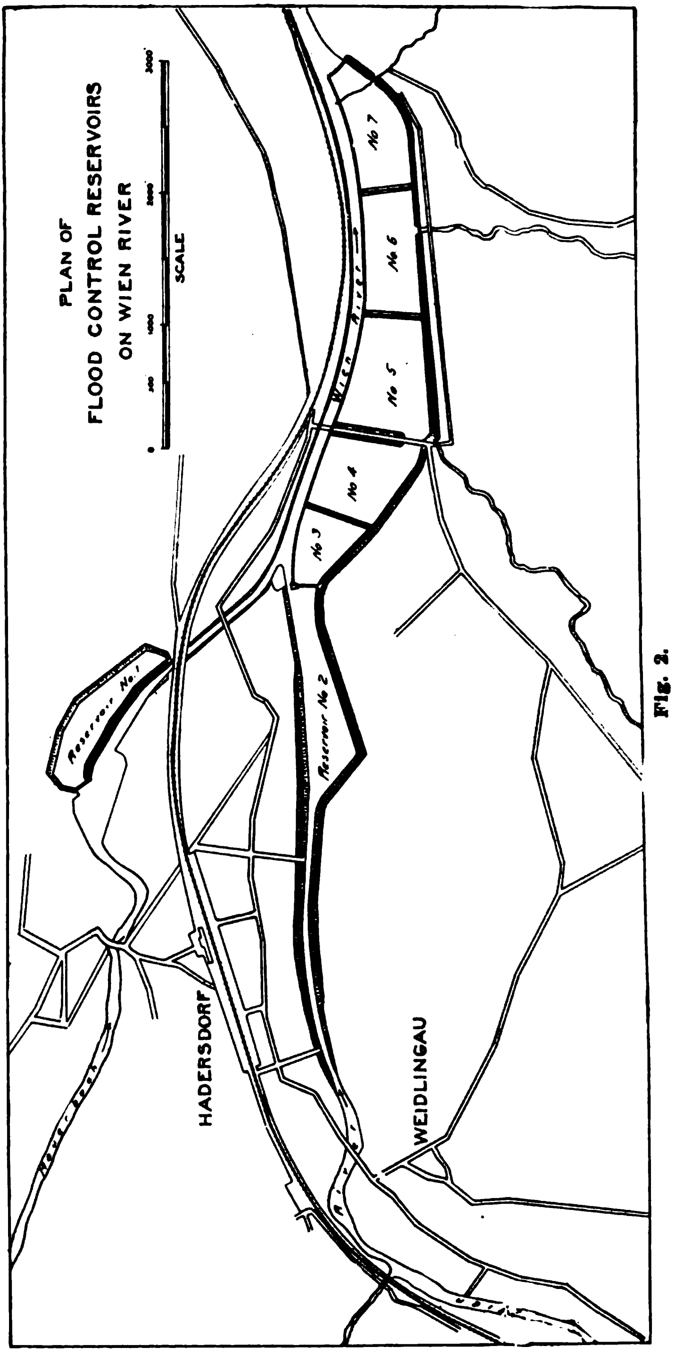

PLAN OF
FLOOD CONTROL RESERVOIRS
ON WIEN RIVER
0
500
1000
2000
3000
SCALE
Reservoir No. 1
Reservoir No 2
No 3
No 4
No 5
No 6
No 7
Wien River
HADERSDORF
WEIDLINGAU

Fig. 2.

The Improvement of the Channel Proper.

The channel at Weidlingau-Hadersdorf, where the Wien is joined by its largest tributary, the Mauerbach, has been given a capacity of 14,120 cubic feet per second, and from here to Vienna the channel is paved throughout, increasing in capacity to 21,180 cubic feet per second. For the first 5 miles from the mouth, the stream is arched over, with a width of from 61 to 69 feet, as shown in the accompanying typical cross-section. The Vienna City Railroad runs along the right bank of the stream, partly in the old river bed, and is separated from the channel and protected from high water by the wall as shown. For 1.9 miles above the arched-over section, the cross-section is open, with a wall on the right bank between the railroad and the river, and a paved bank on the left. The next mile upstream, extending to the reservoirs at Weidlingau, has an open channel with the bottom and banks paved.

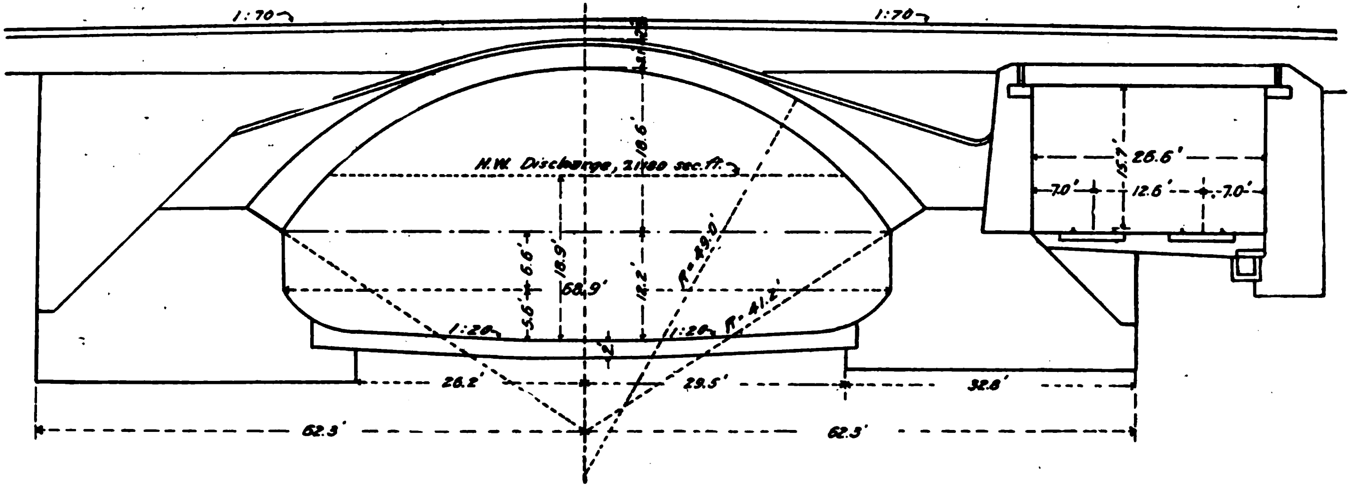
The Flood Control Reservoirs at Weidlingau-Hadersdorf.

The seven flood control reservoirs have a combined capacity of about 56,480,000 cubic feet and are divided into two parts, six of them being for the regulation of the Wien and one for the regulation of the Mauerbach.

The Wien Reservoirs.

As shown in the general plan, the Wien reservoirs are located at the junction of the two streams and occupy the bed of the Wien valley, a new channel for the river having been cut along the left edge of the valley and separated from the reservoirs by a heavy concrete wall. They stretch along the valley for a distance of about a mile and have an average width of about 400 feet and a total area of about 85 acres. They are separated from each other by low concrete dams, and the water surfaces of the reservoirs, when full, form a series of terraces with about 6.5 feet difference in elevation between each, the reservoirs being so cut into the bed of the valley that the highest water stage cannot overflow the surrounding country. The upper and lower dams have a spillway about 148 feet long. The others overflow for the full length of the crest with the exception of the one between reservoirs No. 4 and No. 5, over which a road crosses as shown in the plan. On this dam, a 148 foot spillway is constructed, and the road crosses this by a bridge and runs along the top of the dam for the balance of its length, crossing the Wien channel by another bridge. The water after filling the first reservoir, passes over the spillway into the second, and so on until all are filled, when it flows on into the river over the lowest dam. Each reservoir is provided with gates by means of which it can be emptied in an hour either into the next reservoir below, or into the Wien channel.

The upper or preliminary reservoir is intended to catch silt,



CROSS SECTION OF
IMPROVED CHANNEL OF WIEN RIVER

Fig. 8.

gravel and other debris brought down by the floods, and is provided at the lower end with suitable gratings to prevent floating material, such as logs, trees and brush from passing on down the stream channel. The water upon entering this upper reservoir suddenly loses its velocity and the material in suspension drops to the bottom, the character of the deposit gradually decreasing in size from gravel at the upper end to fine silt near the lower end. At the time the writer visited this work, in August, 1910, there was about 3 feet of deposit over most of the bed of this reservoir, the result of two floods in that year. The material was being carted away, the gravel and sand to be used for building purposes, the silt for spreading on land, for which it has been found excellent, and the wood for fuel. It costs about $4,000 a year to remove this deposit. This outlay is not excessive, however, when it is considered that the purpose of constructing the reservoirs was not only to retard the runoff, but also to prevent the serious damage which in time would result to the costly improvements of the Wien channel below, by the grinding action of the hard gravel, which would pass at high speed and in considerable size down the 5 per cent. slope of the regulated channel. This arrangement also keeps this material from being deposited in the Danube canal at the mouth of the Wien, where it would have to be dredged out.

As a result of the settlement of all suspended material in this upper reservoir, the beds of the lower reservoirs receive no deposit, and they are used for raising grass, two crops of which are cut each year. Ice is also harvested from the reservoirs in winter.

The gate house mentioned above is located at the left end of the uppermost dam, and is designed to control the discharge into the channel below, by directing any desired amount of the flow into the reservoirs. It was assumed in the design that a maximum discharge of 16,940 second feet might occur in the Wien, and this automatic separator or regulating device is arranged to allow only 9,530 second feet to flow down the channel, the remaining 7,410 second feet being directed into the reservoirs. The maximum flow during floods never lasts longer than two hours, as shown by observations extending over a long period, and as the reservoirs take about two hours to fill, by the time overflow occurs, the discharge of the river has lowered to safe limits.

The regulation device consists of a heavy masonry bulkhead, with two openings, across the Wien channel. These openings are about 23 feet wide and can be closed to any desired amount by means of six box-shaped beams or girders, which run one behind the other in masonry guides and can be raised or lowered by means of chains and hand winches located in the gate house on top of the bulkhead. When raised these beams form a step-shaped barrier across the channel, ascending in a downstreamward direction.

The Mauerbach Reservoir.

The Mauerbach Reservoir is located about 1,000 feet above the mouth and is about 1,150 feet long by 260 feet wide. The stream bed immediately above has been widened out into a preliminary or settling reservoir, provided with gratings for retaining floating debris similar to those in the settling reservoirs on the Wien. From the settling reservoir a weir 98 feet long admits water into the flood control reservoir, the elevation of the crest being so placed that overflow into the reservoir begins when the flow of the Mauerbach reaches about 4,590 second feet. A discharge gate emptying into the Mauerbach channel is provided at the lower end of the reservoir.

The total cost of the reservoir work amounted to $1,680,000, and of the channel improvements to $7,920,000, a total of $9,600,000. The control works have proved entirely satisfactory thus far, although there has as yet been no extremely great flood to fully demonstrate their effectiveness.

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AMERICAN PRACTICE IN CLEANING BLAST FURNACE GAS

BY SAMUEL K. VARNES, MEMBER.

Read before the Society on May 16th, 1910.

The remarkably rapid progress made during the last decade in the introduction of gas motors has directed much attention to the improvement of auxiliary apparatus. The modern gas engine plant is just as reliable as a steam engine plant and simpler. The latter type of plant is more complicated with the various units to make a complete whole than is the former, partly, it is true, because the refinements for securing the minimum expenditure of energy in auxiliaries and returning rejected heat to the cycle are more fully utilized. Even with this lack of refinement the well equipped gas engine plant to-day will show a very marked saving in total cost per horse power hour over a steam driven plant, especially in plants of moderate size. The increase in the number and capacity of blast furnace gas engines has far exceeded all other kinds of large engines, and the auxiliary apparatus especially that for preparing and delivering gas to the engine has been given very careful consideration, with in most cases, satisfactory, but in some cases, very inefficient results.

The various factors that might be mentioned as affecting the properties of fuels for internal combustion motors may be divided into two classes; first, those that will affect the efficiency of energy transformation; second, those that will not only affect the efficiency but also prevent the transformation entirely by injury to the engine. Many gas engine designers have succeeded in producing engines that will successfully combat the evils resulting from changes in the quantities and properties of gaseous constituents of the energy carrying medium, but none has yet succeeded in building an engine that will successfully digest continuously a quantity of solid matter. The numerous failures of gas engine installations that have subsequently been traced to an excessive dust and tar content of the gas supplied, should teach a lesson that much too often is inexcusably neglected. Many times the manufacturer of neither the gas producer nor the gas engine feels it incumbent upon him to enlighten the inexperienced purchaser of the need of gas cleaning apparatus until the trouble begins, when each shifts the blame to the other with the result that the purchaser bears the burden. The most conspicuous example to steel men of the lack of proper gas cleaning apparatus is found in the Lackawanna installation at Buffalo, where a major portion of the difficulty encountered in operation was due to dust in the gas, the plant having been installed at a period when the belief was prevalent among American gas engineers that the dust idea was merely a bugaboo of the imitation. Subsequently these difficulties were overcome by the installation of adequate apparatus. It is not necessary or desirable that an engine be built that has the ability to pass through it large quantities of solid material, because of all the constituents found in gases from every source no other one is so readily controlled and easy of elimination by means of properly designed and carefully operated apparatus.

In case coal be the source of energy available one may indeed still hesitate to install a gas engine equipment, but when the fuel is already in the form of gas such as is the case at blast furnaces it is only the exceptional case of unusually low fuel cost that will in any way justify the double energy-transformation entailed by the use of steam apparatus. Blast furnace gas is an almost ideal fuel for internal combustion engines provided its dust and moisture content be sufficiently low, because its sulphur and hydrogen are negligible, its combustible element being made up of practically only one gas, carbon monoxide. That the dust be removed is not optional; it is an absolute necessity, because, neglecting its influence upon the efficiency of the engine, cut and scored pistons and cylinder walls, grooved and leaking valves, stopped gas passages, and clogged igniter contacts and regulating valves cannot be tolerated.

The question of cleaning the gas previous to use in stoves and boilers has, however, a different aspect. Here cleaning is not a necessity and may be or may not be advisable depending upon the relative saving due to the use of cleaned gas and the cost of cleaning. That there is a saving resulting from the use of cleaned gas on boilers, furnaces and in hot blast stoves is questionable. At the Duquesne Works of the Carnegie Steel Company, an increase in boiler efficiency of a 250 HP boiler at 330 HP of from 51% on dirty gas to 64% on clean gas was found. At the same plant the efficiency of a stove on dirty gas was found to be 56% and on clean gas 62%, the latter giving 150° higher blast temperature. The John Cockerill Company, of Seraing, Belgium, found that 200° higher blast temperature was attained, other things being equal, when clean gas was used. At Steelton 1½% lower efficiency and 150° F. lower blast temperatures were found with the clean gas*. The introduction of dirty gas into boiler furnaces results in deposits of fused masses on the tubes of the boilers and economizers, these masses frequently hanging from the tubes as hundreds of stalactites up to one inch in length very greatly reducing the heat transferring ability of the boiler—the gases leave at higher temperatures with consequent loss of energy. The combustion chambers receive deposits of fused ore hard as stone requiring sledges and bars for removal with consequent injury to the brickwork. The cost of repairs in cleaning the boiler of these masses of fused material is a very important item especially when this sum must be paid for the undesirable privilege of operating the boilers at impaired efficiency. Then too, there is the loss of gas when a boiler is being repaired unless there is spare capacity which rarely occurs at a blast furnace plant. This loss on a 500 HP boiler is $3.00 per hour for the time lost. The repair cost of economizers when the boilers use dirty gas is even proportionately more; in fact, we decided at Steelton not to install economizers on boilers taking dirty gas because the net saving did not justify the investment. When dirty gas is fired in a hot blast stove it is said that the rapidity of flame propogation is retarded, combustion is extended farther through the stove and is not so nearly complete as with clean gas, the results being that the mean temperature of the brickwork is reduced and lower blast temperatures are obtained. In addition the cost of cleaning and repairs is higher because the lime of the dirty gas combines with silica of the fire-brick lining consuming the brick, the flues and passages are clogged, the ore fuses onto the bricks and drips into masses at the bottom of the combustion chamber from where it must eventually be removed.

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*These tests were conducted after this paper was read and the statement introduced during revision.

The degree of cleanliness desirable for gas to be applied to different uses varies with the purpose for which it is intended. The majority of gas engine builders base their guarantees upon a gas containing not more than 0.03 grains of dust per cubic foot. This quantity is near the safe maximum and one-third of that amount or 0.01 grains per cubic foot is desirable on account of the reduction in wear of cylinder walls and valves. If the gas be used under boilers or in hot blast stoves it is not necessary to attain such degree of purity. The results obtained with gas containing 0.15 to 0.20 grains of dust per cubic foot are entirely satisfactory; the boilers and stoves show no deposits and any further reduction in dirt content means increased expense for which there is no return.

The general term dust when used in speaking of the suspended material in blast furnace gas includes the mixture of ore, coke, silica and limestone in proportions about as charged into the furnace which is blown out with gas by the force of the blast. This dust is so fine that practically all will pass through a 50 mesh screen and results chiefly from the abrasion of the charge as it descends through the furnace. The ore, coke and silica in such a finely divided state when mixed with oil as in an engine cylinder, have abrasive qualities excelled only by ground emery.

The moisture content of the gas is derived from the water charged into the furnace in the ore, coke and limestone all of which is driven off as steam and carried along by the gas. The quantity of water thus evaporated is dependent upon the qualities of the charge supplied and the method of working the furnace. By-product coke and fine ores requiring to be wet before charging may run the moisture content up to 40 grains per cubic foot of gas or about 900 lbs. of water per ton of pig produced. Twenty-five to thirty grains per cubic foot is common. This moisture reduces the flame temperatures in furnaces or engines in which the gas is used and consequently reduces the efficiency of combustion and of heat transferrence or of heat transformation.

By gas cleaning we mean the removal from the gas of the solid suspended matter called dust, and of the water carried along as vapor.

The solid matter in suspension may be removed by several different types of apparatus all of which, however, depend for their action upon the relatively greater specific gravity of the dust. The water vapor may be removed by cooling the gas. This is commonly done by injecting water into the current of the gas. It may at first seem paradoxical to state that the gas is dried by injecting water. The water injected, however, absorbs the sensible heat of the gas and cools it, causing the precipitation of the moisture originally carried with it. A cubic foot of gas at 350°, a frequent top temperature of a blast furnace, may contain 260 grains of water vapor per cu. ft. (actually there is rarely more than 40 grains present), but gas at 60° Fahr. can contain only 6 grains per cu. ft. The difference may be precipitated by cooling to ordinary atmospheric temperature.

The apparatus for accomplishing this cleaning may be roughly divided into two general classes: stationary and rotary. Of the stationary class there are two general types: (a) dry, and (b) wet, the division being dependent upon whether or not water is used in the apparatus to assist in the cleaning action.

The rotary class of apparatus may be further sub-divided into two types: (b) high speed and (b) slow speed, the division being based upon whether or not the speed of rotation is sufficiently high to depend upon centrifugal force for the cleaning effect. All of the rotary class of apparatus is of the wet type, water being used to entrain the dust.

The dry type of stationary apparatus may be classed as follows:

Settling Chambers.

This may be said to represent the primitive apparatus used for blast furnace gas cleaning for it was by increasing the cross sectional area of some portion of the gas passage that an attempt was first made to arrest the dust in its course. An increase of area of the gas main results in a decrease of the velocity of the gas through that section and the heavier dust particles are dropped. If the velocity of the gas be sufficiently high the force of gravity cannot bring the dust particles to rest because in order to do so they must cross the path of the gas particles which by impact increase the store of kinetic energy of the dust, but by decreasing the gas velocity the particles lose kinetic energy and are drawn down by gravity and, if the velocity be low enough are dropped. In case the velocity be reduced to zero all the dust particles would eventually fall out of the gas. The increased sectional area of the main was extended until it became a chamber of very large volume inserted into the course of the gas. Theoretically gas could be perfectly cleaned of dust by a settling chamber, but the dust particles are so small that a chamber of impractically large dimensions is necessary to accomplish it. A chamber of infinite cross section would be necessary for complete cleansing.

The Baffle Dust Catcher.

The next step was to make use of the kinetic energy of the dust particles to carry them out of the line of flow of the gas. This was accomplished by causing the gas to enter a chamber in one direction at high velocity and compel it to leave at reverse or partially reverse direction, the dust particles being projected into a chamber or against a wall where their motion was arrested, or by causing the gas to impinge upon a wall over which it was conducted to the outlet. This apparatus is usually combined with the one just described so that the action takes place in a large chamber when the gas velocity is reduced. The performance of this apparatus for the same size and space occupied is superior to the simple settling chamber, but the gas in reversing its direction always agitates sufficient of the dust to carry a large amount of it along. I dare say that more than fifty per cent. of the blast furnaces in America that boast any cleaning devices have this particular type. On an ore of the fineness of Mesaba its efficiency of dust removal is approximately 50%; that is, one-half of the dust entering will be retained.

Centrifugal Dust Catcher.

The centrifugal type as shown in Figure 1 is the latest type of dry cleaning devices and is by far the most efficient. The gas enters at one side near the top in a tangential direction and at a considerable angle above the horizontal and leaves at a point several feet higher on the vertical centre line of the cylinder forming the chamber. The gas is caused to impinge at an angle upon the wall of the chamber, is then given a swirling centrifugal motion, is next reduced very greatly in velocity, has its direction almost exactly reversed and leaves at the top the very most difficult place for the dust to reach. It is thus seen to have a desirable combination of all the effects produced in the other devices and the results attained in practice prove it to be a remarkably efficient apparatus for its size and cost. The number of installations is as yet comparatively few, but none has been reported that has not given entire satisfaction. Its efficiency is usually 70% and over.

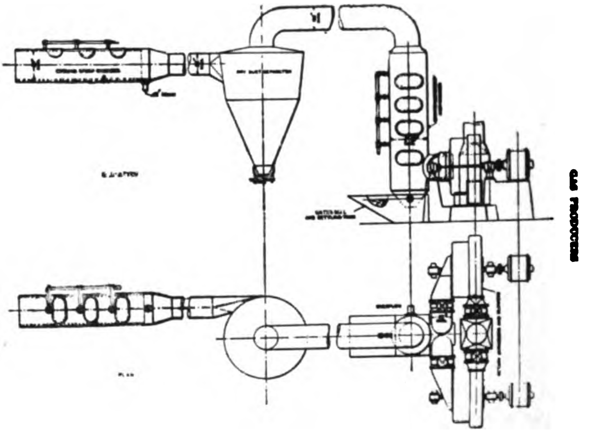


Fig. 1.

The Brassert-Witting dry gas cleaner, Fig. 1a is a refinement of the centrifugal dust catcher. The gas is delivered tangentially through inlet pipe (1) to the main chamber (2) where it is whirled about the annular space between the outside shell and the inside flue. The outside shell has rivetted vertically to it "Z" bars (7) as shown in detail of enlarged section. The dust is thrown by centrifugal force into the channel like spaces back of the "Z' bars' extended legs where it is not easily caught up again by the current of the gas, and then drops along this channel to the dust chamber beneath cone (5). The gas passes under the end of the central flue (3) and up through this flue leaving at (4), cone (5) preventing it from stirring up the dust in the settling chamber. The cleaning effect is due to centrifugal

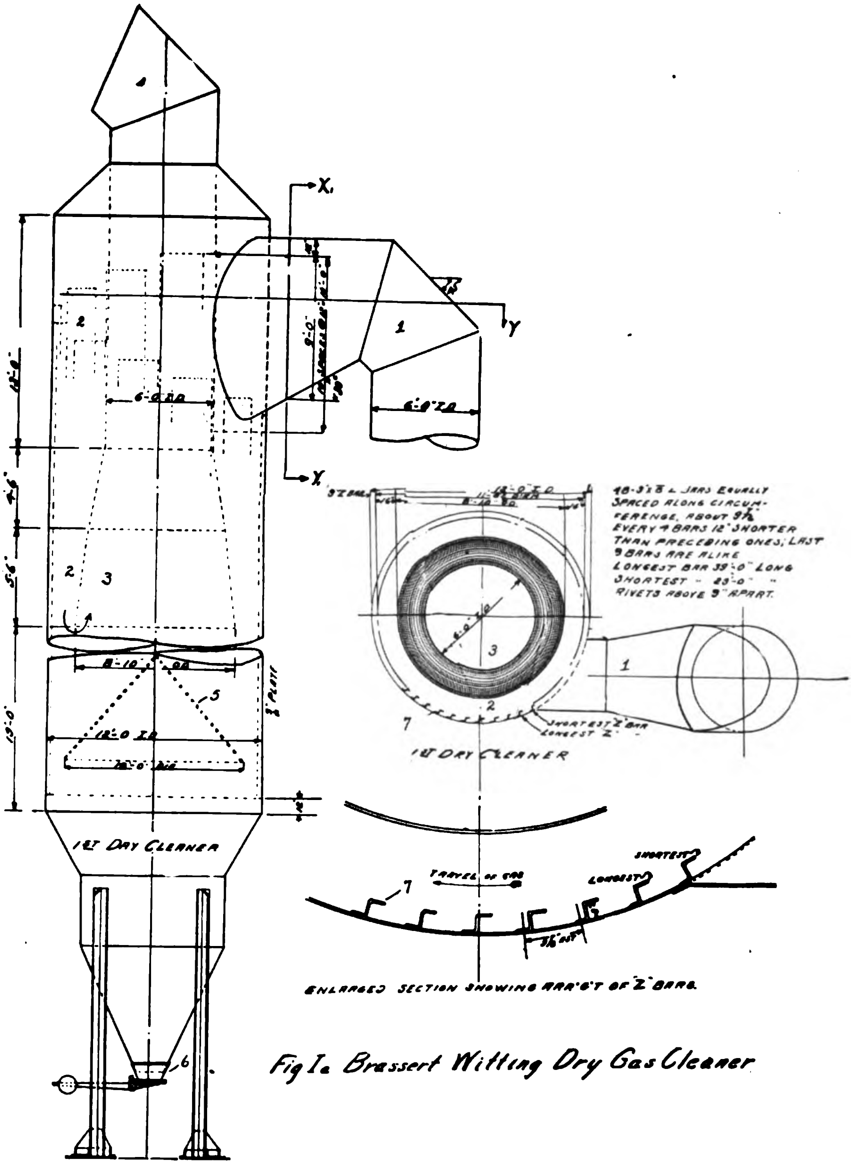


Fig I. Brassert Witting Dry Gas Cleaner

force, baffling, reversal of direction of flow and sudden expansion, as well as protection of the deposited dust.

A ten foot cleaner of this type is said to be more efficient than a 40 foot centrifugal dry dust catcher, and three such cleaners in series to clean gas to a dust content of less than ½ grain per cubic foot.

All these devices come under the general appellation of dry dust catchers. None of them, excepting possibly the Brassert-Witting will clean gas sufficiently clean for satisfactory use under boilers or in stoves but they have taken a place in American practice as preliminary apparatus that will probably be maintained for a long period. Their very important advantages are: first, providing an efficient device having no moving parts; second, the cost of repairs is practically negligible; third, accumulated dust is dumped into a car beneath the hopper which is usually done by the furnace attendants; fourth, there is no expense for power or water; fifth, seventy per cent. or more of the dust is removed in the best type.

The "wet" class of cleaning apparatus includes the following devices:

Coke Scrubber

This device consists of a cylindrical chamber usually three or four times as high as wide and having broken coke placed on shelves within the cylinder down through which water trickles while the gas passes upwards through the interstices of the coke. The gas and water are thus brought into intimate contact and the dust particles are entrained by the water and carried out through a water seal at the bottom of the apparatus. This device has been successful in cleaning producer gas and was naturally tried among the first devices for the thorough cleaning of blast furnace gas, but without any success, because the enormous quantities of dust carried by the gas soon clogged the apparatus and shutdowns were of very frequent occurrence. Unless the apparatus be of prohibitive size the velocity of the gas through the comparatively small proportion of the total area presented by the voids between the pieces of coke is so high as to entrain considerable water, a very undesirable effect. Briefly, coke scrubbers may be said to have no place in the cleaning of blast furnace gas.

Grid or Zschoche Scrubber.

This is practically a coke scrubber where the design definitely fixes the area of the gas passages alongside the water covered surfaces. The coke is replaced by wooden or iron slats set on edge and each layer running at right angles to the one above, the alternate layers being staggered so as to form a checker work through which the gas is compelled to ascend. Water as in the coke scrubber is introduced at the top through one or more fixed nozzles and in some designs more is supplied at points farther down the tower. This design is very much more effective

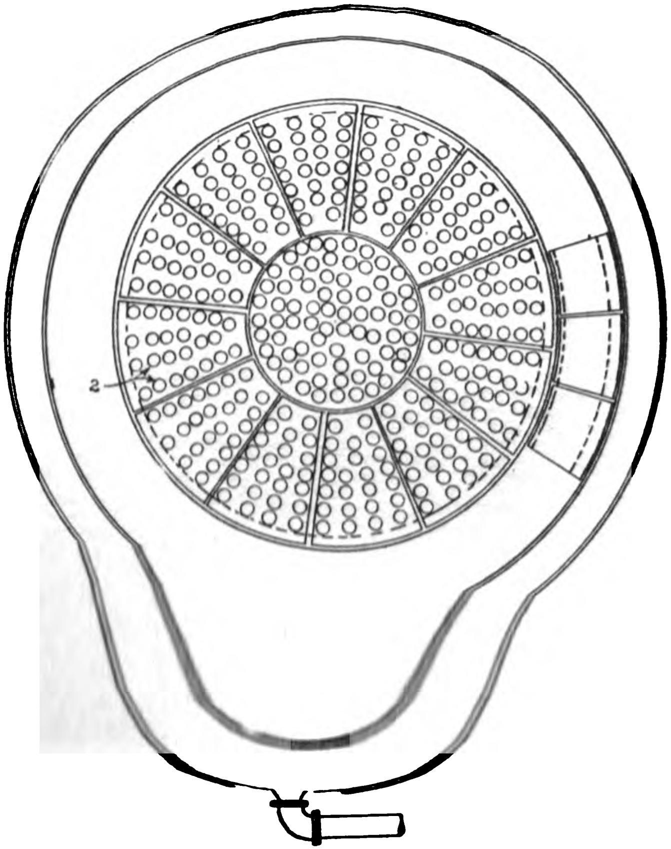


Fig.2-Mullen Impinging Washer.

than the coke filling because the gas velocity is reduced, the water distribution more nearly uniform, and the liability to clogging very much less. This design was first used by the Zschoche Machin-Fabriks of Germany and has been successfully used in a number of places in America. It has the disadvantage, but in very less degree, of the coke scrubber that all of the area of the tower is not effective for the gas passages, consequently, the time taken by the gas to pass through the tower is materially less than if the grids were absent. A further disadvantage is that in case hot gas is allowed to strike the grids incrustation will take place unless an additional and otherwise unnecessary amount of water is used to prevent it.

Impinging Washers

The Mullen Washer, Fig. 2 is a device in which the gas enters at the top (1) of a chamber partially filled with water, passes down through 6" tubes (2) located a few inches above the water and impinges upon its surface, the heavy dust particles are driven into the water and entrained by it passing into the settling basin below. The gas reverses its direction and leaves at the side (3) near the top. The sludge is flushed out at (4) to a sewer (5) the overflow water being carried off by pipe (6). The efficiency of this apparatus as a dust remover is very high, being close to

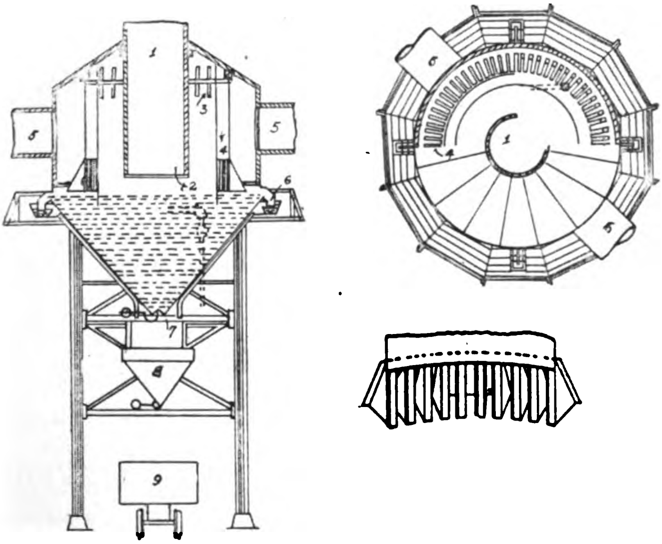
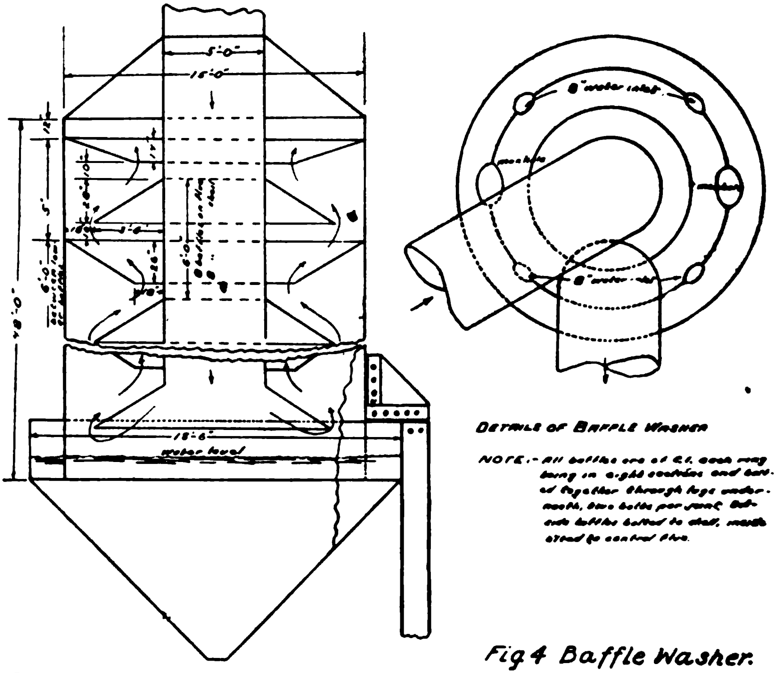


Fig. 3—Moyer Impinging Washer.

90%, but owing to the fact that the gas is cooled only a few degrees in its passage through the washer its moisture content is reduced but little and is often increased, a disadvantage that is inherent to the design. The Moyer washer, Fig. 3 is a modification of the washer just described. The gas enters through a central flue (1), impinges upon the water surface at (2), passes through openings (3) into an annular chamber and caused to impinge a second time upon the water just below rectangular openings (4) leaving by the horizontal flues (5). The water overflow at (6) goes to waste. The sludge removal is accomplished by opening (7) delivering into a storage hopper (8) discharging in turn into a car (9). The efficiency of this washer is practically the same as that of the Mullen and it is open to the same criticism.

Baffle or Film Washers

This type of washer as usually built consists of a tower having a central flue to which are attached a number of cone shaped rings in alternation with a set of inverted cone shaped rings attached to the outer shell. Water is introduced at the top and passes down through the tower in a series of cascades, the gas passing up through these water films and leaving at the top. Fig. 4 shows a vertical section and a plan view of such a washer. These towers as a rule are wasteful of water if satisfactory results are attained as will be more fully discussed later.



DETAILS OF BAFFLE WASHER

NOTE.- All baffles are of C.I. each ring being in eight sections and bolted together through lugs underneath, two bolts per joint. Outside baffles bolted to shell, inside bolted to central flue.

Fig 4 Baffle Washer.

Spray Towers

This kind of scrubber consists of a plain cylindrical tower with some device at the top distributing water uniformly over the whole area and causing it to fall in the form of drops through the tower, thus producing a "rain storm." The gas enters at the bottom and leaves at the top. There are various schemes in use or that have been proposed for distributing the water to such a tower and obviously the chief difference between the towers consists in the distributing devices. One device due to Mr. Steinbart, of Pittsburg, consists of a special chamber with a slot in the under side about 120° long. Water under pressure is conducted to this chamber and the chamber, which is suspended at the top of the tower, is rotated. The water spreads out fan shape upon leaving the slot and due to the rotation descends through the tower as a helical sheet. The diameter of the tower to which such a distributor could be applied is limited. A modification of this device in use at Duquesne Furnaces, Fig. 5, consists of a pipe with a slot in the under side, water being conducted to it through a vertical pipe screwed into a "T" in the middle of the horizontal pipe, the whole device being rotated by a motor outside the tower, a water sealed gland preventing leakage of gas. To the pipe is riveted a curved sheet of boiler plate which projects underneath the slot so that the water leaving the slot drops onto the plate from which it trails off as the pipe rotates. About ten feet below this pipe six screens of one inch to one-half inch mesh are arranged across the full area of the tower, these screens being about six (6) inches apart. The helical sheet of water leaving the rotating pipe is very effectually broken up by the screens into drops in which form it descends through the tower. The gas enters at the bottom and leaves at the extreme top.

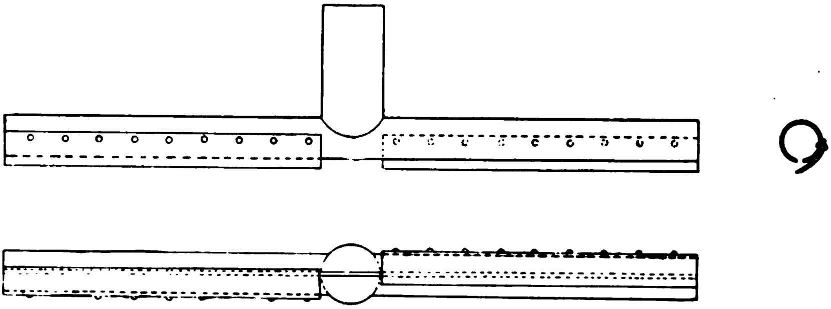


Fig. 5 — Duquesne Distributor.

The distributor which has been developed at Steelton, Fig. 6, and is now being installed in two towers there consists of a horizontal rotating wheel (A) with a flat upper surface. This surface (C) being covered with ¼″ mesh wire screen. About four inches above the screen fifty-two nozzles (D) properly distributed discharge water parallel to the plane of the screen and against its direction of rotation. These nozzles are 1¼″ inch standard pipe, Fig. 7, bent through 90° over a 12″ radius. Any one of the

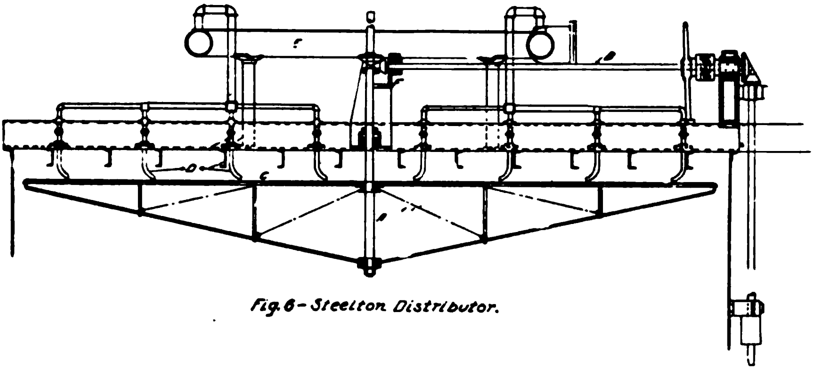


Fig. 6 - Steelton Distributor.

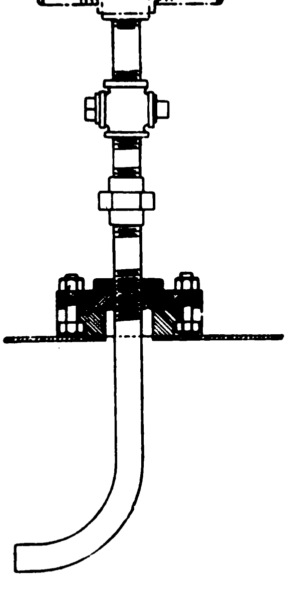


Fig. 7 - Detail of Nozzle used with Steelton Distributor

nozzles may be removed from the outside of the tower in case it clogs. The wheel is motor driven from outside the tower through shafts and bevel gears, the motor being located at the base of the tower. A circular manifold pipe (E) 10" in diameter supplies the water to the nozzles. The distributor is designed to work at one pound pressure on the manifold. A full sized model of this distributor was built and tested with the results that promise practically uniform distribution of water over the whole area of the tower. The gas enters the bottom of the tower in a downward direction so that it must impinge upon the water seal, then ascends through the tower leaving at the side close to the top.

Certain designs of spray towers use no moving distributor but depend upon nozzles of special design to break the water into drops and distribute it. The opposed jet spray, Fig. 8, gives very good distribution and breaks the water into a mist but it has two very serious disadvantages: First, it requires at least 60 lbs. pressure to operate it satisfactorily and second it will clog very

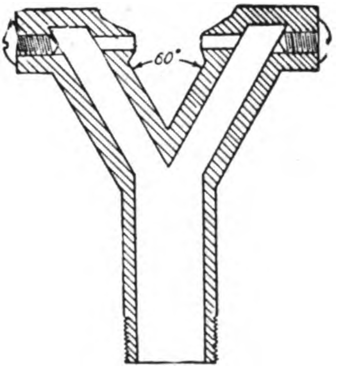


Fig. 8.

quickly if water containing any dirt be used. The umbrella sprays, Fig. 9, so called are not so good distributors and will cover only a small area from each. They are less likely to clog than the opposed jet type and can be operated on five pounds pressure. The number of such sprays required for a large tower is so great, however, that the installation becomes burdensome. A spray nozzle which gives remarkable good distribution of small drops of water is the Koerting nozzle. Each nozzle can be built to cover a reasonably large area, making the installation

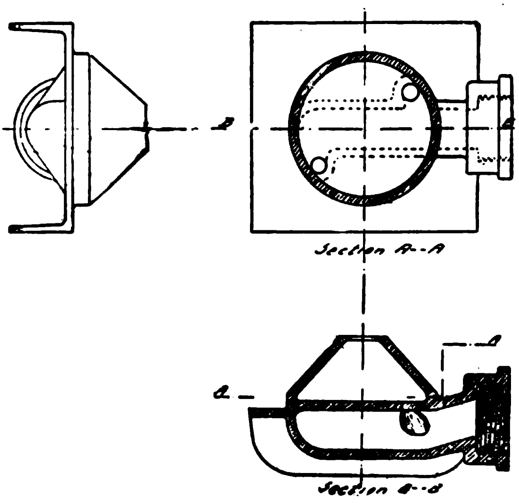


Fig. 9.

consist of a small number of fairly large parts that do not savor of the clock making industry. The construction shown in Fig. 10 permits of readily inspecting and cleaning the nozzle from the outside of the tower. To the left of the nozzle is shown an arrangement of such nozzles now in service and an idea of the simplicity of such an installation. The water pressure required to operate is from 15 to 20 pounds, which is a considerable disadvantage where a total head of that amount above the top of the tower is not available.

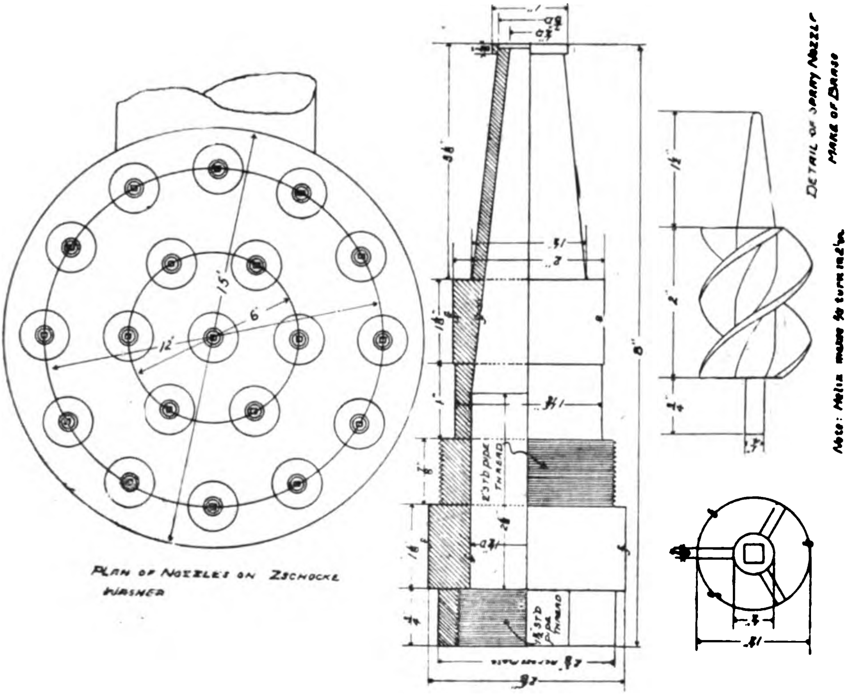


Fig. 10–Koerting Spray-Nozzle.

The wet types of stationary cleaning apparatus have a well defined place in American practice as a secondary stage in the cleaning process. Although the combinations and the arrangements differ in the individual plants it is nevertheless characteristic of American cleaning plants that some form of dry cleaning apparatus is designed to perform the rough work and immediately following is a distinct secondary stage of wet stationary apparatus. Local conditions modify the designs so that no one may be said to be best suited to all conditions. The coke scrubber can be neglected entirely. The Zschoche or grid tower in most installations has been preceded by a baffle or film tower and it is with this arrangement that it works best because the gas is then pre-cooled and incrustation troubles are avoided. The idea, however, of building a chamber of large volume and then partially filling that chamber with obstructions so that the velocity of the gas is two to three times what it would be if the grids were absent, allowing only 1-2 to 1-3 as long time for the scrubbing action, seems on the face of it a waste of money. The ideal grid washer would theoretically be attained having grids of infinitesimal thickness with a layer of water on each side so that the gas would pass through a checker work of water walls, the whole space except that occupied by the water being available for gas passages. This, however, is impossible of attainment because practical considerations of strength, durability and resistance to corrosion limit the minimum thickness that may be used. Suppose we go a step farther and consider the grids eliminated and that the thickness of the water films is only one-half that it was in the case of the infinitesimally thin grid; there would be only one-half as much water required, but since the gas could reach both sides of the film just as much area would be presented to the gas. If the films should be further sub-divided into drops of a diameter equal to the thickness of the film very much more contact area would be available. This brings us to the spray tower which with proper distributing and spraying devices presents for a given amount of water the maximum contact surface to the ascending gas. Other things being equal, the greater the contact area the greater the probability will be that the dust particles will come into contact with the water and be entrained by it. The surface tension of large drops or of films of water is frequently too great to allow the finer dust particles to break through when they do come in contact and in order to be entrained they must break through. Anyone who has seen furnace flue dirt lay for hours on top of a pool of water without sinking will readily appreciate this point. If, however, the water is divided sufficiently fine the dust particles are then surrounded and enveloped by the smaller water globules which are retained on the rough surfaces. A tower containing water mist, however effective it would be in wetting the finest dust particles, would be poor cleaner for the weight of the wetted dust would, to a great extent, be too light to settle against the current of the gas. In the spray tower the conditions are such that the water having been broken into drops at the top is further sub-divided into smaller drops as it descends arriving at the bottom as a cloud of mist. The production of the mist is materially aided by the evaporation at the very bottom of the tower of considerable water by the incoming hot gas and subsequent condensation of this vapor at a point farther on its course. The mist envelops the dust particles which are weighted down after being wetted, by the larger and heavier drops at the top of the tower. There is an advantage then in having the gas arrive hot at the bottom of the spray tower, but it is not advisable in a grid tower.

The baffle washer when used is in most installations preliminary to the grid washer. This tower has the advantage of insuring contact between water and gas by compelling the gas to pass through the cascades but whoever has had experience with such conditions knows that it is practically impossible to obtain a uniform thickness of overflow, consequently, the gas will channel through the thinner section and only by using a number of such sheets is there a surety of securing contact. The water consumption of such a tower is usually comparatively high owing to the endeavor to increase the thickness of the sheets of falling water and reduce the channeling action that the cleaning may be sufficient.

A Zschoche tower, a baffle tower or a spray tower of proper proportions and given sufficient water will take gas containing 1.5 to 3.0 grains per cubic foot of dust and clean it to a content of only 0.15 to 0.20 grains per cubic foot and cool it to within four or five degrees of the temperature of the supply water. The spray tower can usually be built for no more, possibly less, than the other types, will cost no more for repairs and attendance, and can be made to do the same work with a lower water consumption. This fact has been proven in actual service at the Duquesne plant which, having a spray tower equipment, uses less water than do the Zschoche and baffle tower plants.

Taking up the rotary class of apparatus we find only one slow speed washer that has attained any prominence, Fig. 11, the Bian washer, consisting of a series of circular screens mounted upon a spindle and rotating slowly in a closed chamber filled half full of water. The screens dip into the water carrying a film of it on the screen into the upper part of the chamber where the gas is compelled to pass through these screens. It is used somewhat abroad but not in any blast furnace installations in this country. The objection to it is that which applies to any device which compels the gas to pass through screens—the loss of pressure through the screens is very high. The screens clog quickly if hot gas touches them, especially if the dust has hydraulic properties.

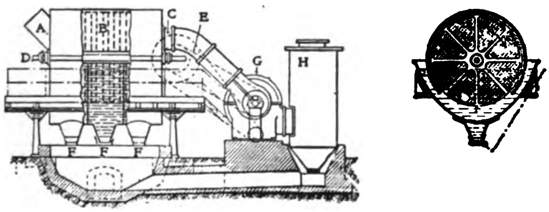


Fig. 11.

The high speed device that was first tried was the centrifugal fan of ordinary design using three or four nozzles to inject water into the gas entering the fan. The fan picks up the water and gas, dashing them violently against the casing and pressing the two into intimate contact and wetting the dust particles. But here the action ceases, the time of passage of the dust is so short that no opportunity is given for the dust and the gas to separate and indeed insufficient time is given for mixing the gas and water. The only dust removed in the apparatus itself is that carried out at the water seal at the bottom of the casing. For gas containing three grains of dust per cu. ft. at 350° Fahr. three fans in series are necessary for complete cleaning; the first evaporating the water injected and mixing the resulting stream and water, the second and third condensing the steam and wetting the dust which is removed in a water separator following the third fan. The fans are wasteful of water and power and are not efficient cleaning devices. With the more efficient devices now at command there is no need to use one that has so little merit. It filled the need until the arrival of the better devices but that is no excuse for pensioning it into a new plant.

The list of high speed rotary washers that have been successfully used for gas cleaning includes the Theisen, Saaler, Schwartz and Berg. These different designs are fundamentally the same in that they enforce contact of water and gas driving even the finest dust particles into the water. The Theisen washer, the most widely used abroad and almost exclusively in the United States, is shown in plan and sectional elevation in Fig. 12a. A horizontal shaft (9) carries a boiler plate drum (5) on spiders and diaphrams. To the outside surface of the drum are riveted a number of plates (2), standing at an angle to the shaft and forming helical vanes. The angle of inclination is shown by the dotted line passing through the centre line of the plan view. The vanes are wider at the right hand or gas entry side than at the left. To the extreme left end of the drum is attached a fan wheel (3). Gas entering at (1) is sucked through the washer by the exhauster fan (3) and discharged to (4). The helical vanes (2) act to resist the passage of the gas and force it back, the result being that it is caused to hug the casing (8) beyond the tips of these vanes and the forward sides of the vanes themselves thus compelling the gas to follow a helical path of several turns on its way through. Water is introduced at (6) and flowing in a direction opposite to the gas leaves at (7). The water, too, is forced tight against the casing and made to take a helical course, but in opposite direction to the gas, consequently insuring intimate contact of gas and water. The inside of casing (8) is covered with a coarsely woven wire screen, the wires set at an angle to the shaft so as to assist the helical flow of gas and water, the rough surface of the screen assisting in admixture of water and gas. This washer is remarkably efficient as to water and power consumption. In this country it is always preceded by some type of dry cleaner and wet stationary washer, but abroad in many installations the Theisen takes gas direct from the furnaces and delivers gas cleaned 0.10 to 0.20 grains per cu. ft. for use in stoves and boilers while a second Theisen takes gas from the first and cleans it for use in gas engines. European top temperatures are usually about 300° to 350° F. and the Theisen will give its best efficiency taking gas at this temperature, but in American blast furnace practice top temperatures are 500° to 700° more often than under and the Theisen will not successfully take care of such high temperatures because the vanes clog up from incrustations.

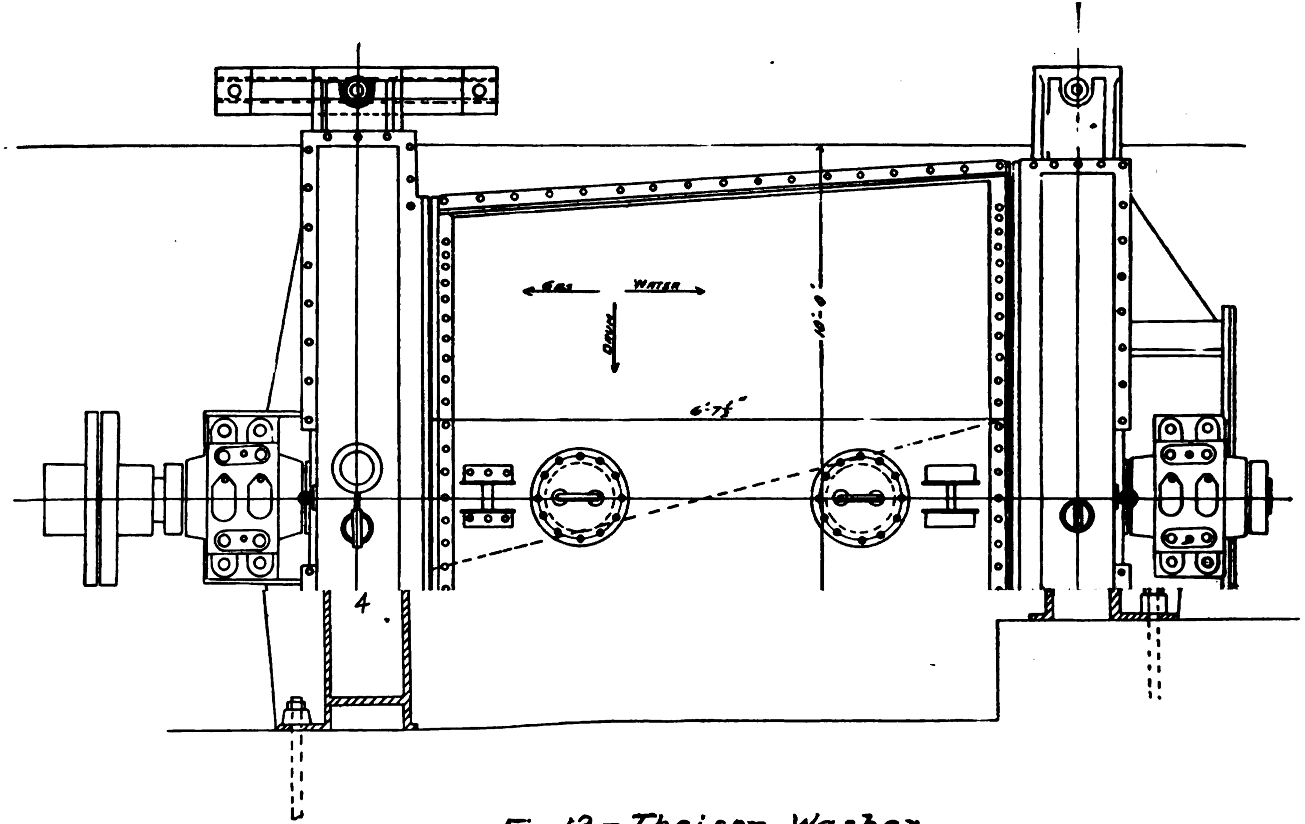


Fig. 12a – Theisen Washer.

In the following paragraphs is given in more or less detail a description of each of eight representative gas cleaning plants.

At the Buffalo plant of the Lackawanna Steel Company was erected the first extensive American blast furnace gas engine plant. The cleaning apparatus as originally designed and installed was found to be inadequate and subsequently changes were made and the efficiency of cleaning much improved thereby. The plant is not an example of present day methods, but it is highly interesting historically in that it marks an early stage of American development of cleaning devices. The gas engine installation was made in 1902 and in 40,000 HP capacity. The engines are of the Koerting two cycle type requiring even more careful cleaning of the gas than do the four cycle engines now in common use. Fig. 12 shows a plan of the cleaning plant, as located between two large furnaces. Each furnace delivers gas through its downcomer to dry dust catcher (1), which is a simple settling chamber, taking gas on the top at the centre line and discharging it at two points near the bottom. One of these discharge openings leads to the wet cleaning plant, the other to the stoves by way of gas main (10). The wet cleaning plant consists of eight water spray towers equipped with Koerting distributing nozzles and arranged in two groups of four towers each. These towers have shelves forming successive compartments through which the gas must pass. From the towers the gas is delivered to two groups of centrifugal fans (7). Water is sprayed into the fans and accomplishes considerable cleaning, but the time of mixture and contact is too short to allow thorough entrainment of the dust. The two groups of fans can be used either in parallel or in series. After passing the fans the gas enters a water separator (8) which removes the major portion of the mixture of water and dust before allowing it to pass on to clean gas main (9) which in turn delivers it to the stoves through (10) or to the engines through (11). The water separator is a cylindrical chamber within which channel beams are placed vertically with the legs facing the inlet pipe and separated a short distance in order to allow the gas to pass through between. Above these beams are arranged two cone sheets designed to catch any water escaping the first baffles. The fans may be separately cut out of service of by-passed when desired.

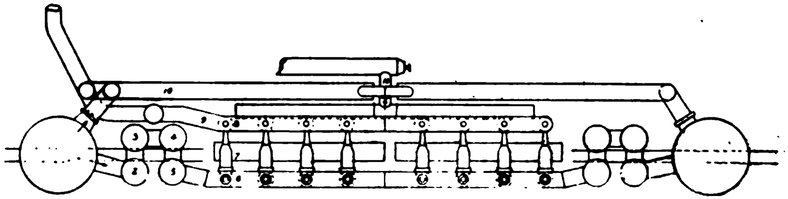


Fig 12 · Lackawanna Steel Company
Gas Cleaning Plant

Edgar Thompson

Next after the Lackawanna installation the Carnegie Steel Company installed at its Edgar Thompson Works a small horizontal Westinghouse engine direct connected to an electric generator. The engine was supplied by gas through a cleaning plant that was the subject of very extensive tests and after many trials of various experimental constructions the plant now in use was evolved as a result of the information obtained. Two plants similar in layout, are in service, one in supplying the generator engines the other the gas blowing engines. The description refers particularly to the latter.

Gas is discharged by the downcomer into a vertical cylinder (1), Fig. 13, 20′ in diameter by 35′ high which is a simple settling chamber. The gas enters at the top and centre and leaves at the side about 10′ from the bottom, going thence to a second dry dust catcher (2) consisting of a horizontal cylinder 10′ in diameter by 20′ long having dust bells at the bottom—a simple settling chamber. The gas enters at one end in a downward direction, and leaves at the other end at the top in an upward direction. From (2) the gas takes two courses going either directly to the stoves and boilers or to the rough gas main (3) connecting to all of the eleven furnaces and thence to the wet cleaning apparatus. Each plant contains duplicate apparatus operated in parallel except during repair periods, when one-half only is in service. Gas coming from the rough gas mains (3) divides part going through each of two mains (4) to spray tower scrubbers (5). Koerting spray nozzles are used as distributors. The gas enters the bottom of these towers, passes upwards against the falling spray, and returns to the bottom by way of a central flue. The towers are 10′ 6″ in diameter by 40′ high, the gas flue being 54″ in diameter. A Buffalo Forge Company fan (6) 10′ in diameter takes the gas and discharges it into the bottom of a baffle or film washer (7)

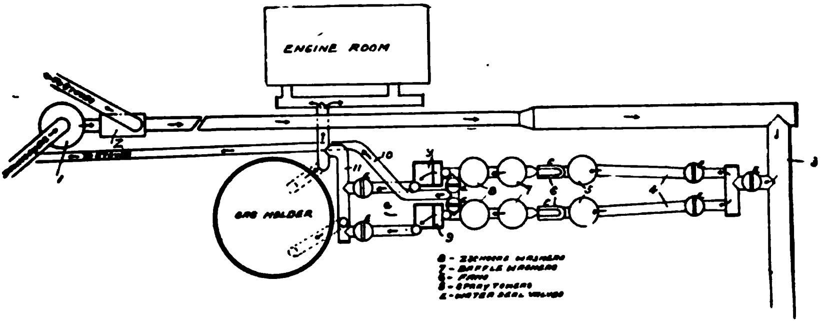


Fig. 13 - Edgar Thompson Steel Works Gas Cleaning Plant.

which is of the same general dimensions as (5). The fan is direct connected to a 135 HP motor running at about 800 R. P. M. and actually consuming about 100 K. W. Water is sprayed into the gas as it enters the fan wheel. The construction of the baffle washer is the same practically as shown in Fig. 4 except that the central ~~flue conducts the~~ gas from the top of the tower, after it has passed through the water to the base and ~~out~~, ~~delivering~~ it to the bottom of a Zschoche washer (8). This tower is also of the same general dimensions as the two preceding, i. e. 10′ 6″ by 40′. The grids are installed in thirteen sets so that the grids of any one set may be repaired without disturbing the other sets.

The towers all have open bottoms which dip into water seals and discharge the dust laden water into a settling basin about 40′ square from whence a locomotive crane and grab bucket removes the sludge periodically. The maximum velocities in normal operation are, for the spray tower 90′ per minute; for the baffle tower 270′ per minute; and for the Zschoche 108′ per minute.

From the last tower the gas can go through gas main (10) to the stoves or through Theisen washer (9) to clean gas main (11) and thence to the engines.

The tower scrubbers take in total about 83 gallons of water per 1,000 cu. ft. of gas cleaned and the Theisen takes about 7.6 gallons more. The power requirements are approximately 0.217 K. W. hrs. for the fan and 0.325 K. W. hrs. for the Theisen per 1,000 cu. ft. of gas.

Carrie Furnaces

The cleaning plant of the Carrie Furnaces of the Carnegie Steel Company is shown in Fig. 14. Gas from No. 6 furnace is delivered by downcomers (A) to dry dust catcher (B). This chamber is 35 feet in diameter by 20 feet high on the cylindrical portion. The gas enters at the top and leaves at the side near the top as in the dry cleaner at the Edgar Thompson Works. From (B) the gas can go direct to the stoves or through impinging washer (c) to either the stoves or primary clean gas main (D). The impinging washer is of the same general dimensions as (B). The gas enters at the top and centre, passes down through a central flue, impinges upon the surface of the water filling the bottom of the chamber to within a few inches of the end of this flue, giving up a portion of its dust to the water, and leaves at the top near one side. When this washer was first built it was equipped with spray nozzles at the top and wooden grids as in a Zschoche washer, but this arrangement entrained so much moisture in the gas that blast temperatures could not be maintained and after about one week's service the water sprays were abandoned. The gas main (D) has connections to each of the other furnaces at this plant, thus insuring a constant supply of gas to the secondary cleaners. The baffle or film washers (E) take gas from (D) and deliver it to a fan (F), the baffle washer

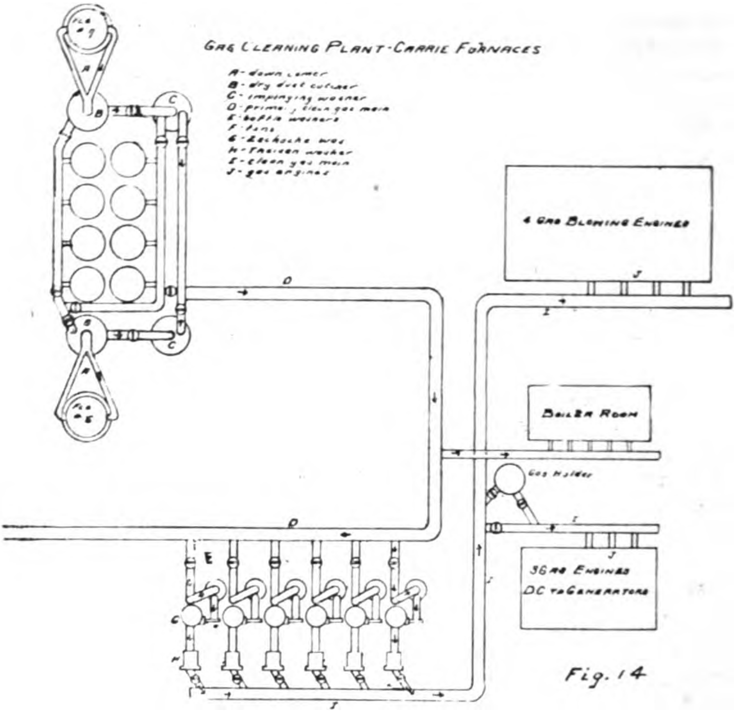


Fig. 14

being similar to that shown in Fig. (4). The fan takes gas from the top of (E) near one side and delivers it at the base of Zschoche washer (G) in a tangential direction. These fans are used only occasionally, when the pressure drops below 3″ water on the inlet side. Zschoche washer (G) is a plain cylindrical tower 40′ high by 15′ in diameter. Koerting spray nozzles of special design, nineteen in number, distribute water at the top. The grids of which there are thirteen sets are made of $\frac{7}{8}$″ lumber, the spacing being 1″ on the top set and 4″ on the bottom set, intermediate sets varying between these limits. A concrete basin forms a water seal for the Zschoche and a sheet steel basin a seal for the baffle washer. From (G) the gas goes to a Theisen washer (H) and thence to clean gas main (I) and the engines (J).

The maximum gas velocity of the bafflle washer is about 170′ per minute and of the Zchoche 56′ per minute. Water consumption is approximately 67 gallons for the baffle washer, 38 gallons for the Zschoche and 6.25 for the Theisen per 1,000 cu. ft.

Duquesne

The plan of the cleaning system in use at the Duquesne works of the Carnegie Steel Company is shown in Fig. 15. It is located between No. 5 and No. 6 furnaces as indicated. Gas from the downcomer (A) passes through two centrifugal dust catchers (B1) and (B2) in series from whence the gas can go directly to the stoves or into rough gas main (C). The general dimensions of these centrifugal cleaners are 30 feet in diameter by 50 feet high. The first of the two does 85% of the work of the two, consequently, the second is scarcely a profitable investment. The rough gas main, 10′ 6″ in diameter runs the entire length of the furnaces and is so connected that the cleaning plant can take gas from any one of the six furnaces. From the rough gas main the gas enters the base of scrubbing towers (D). These towers are nine in number each 12′ 6″ in diameter by 87′ high. The gas discharge is into primary clean gas main (F) which delivers gas through fans (G) and water separators (H) either to the stoves and boilers or to the Theisen washer (I). The distributor in use in these towers is shown by Fig. 5 and described in connection therewith. A five horse power motor propels the distributor. The bottom of the tower is closed except for an eight inch discharge pipe. The sludge removal by this means is incomplete and because of clogging of the outlet the towers must be taken out of service occasionally and this sludge removed manually.

The four fans shown were found to cause a loss of pressure instead of an increase as originally installed and after increasing the speed to secure boosting the cost of operation was so high that the rotors were removed and their use abandoned entirely. With water injection into the fans while in service it was found that gas could be delivered barely clean enough for engine use.

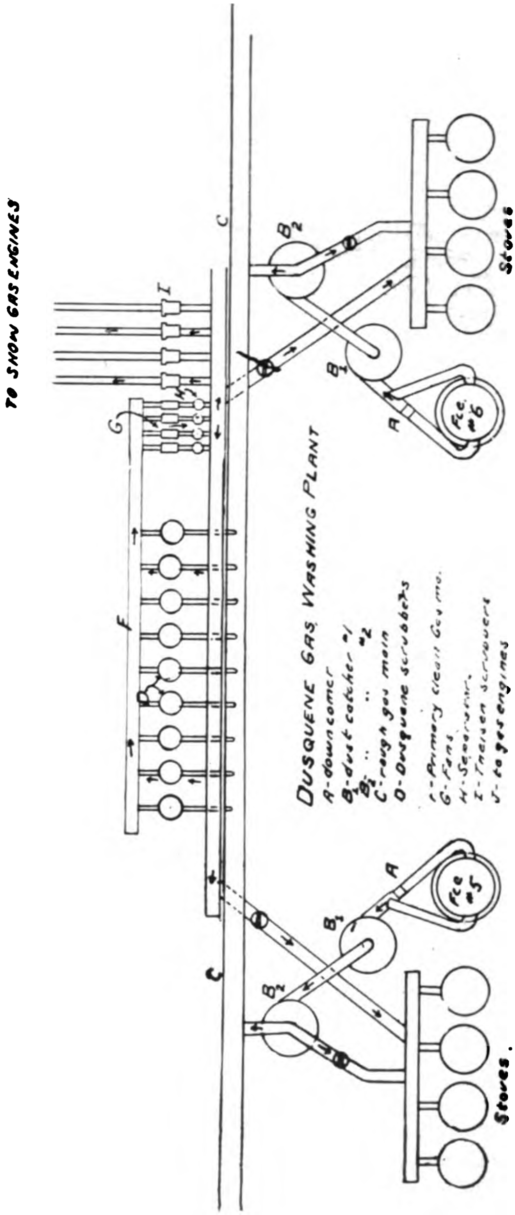

TO SHOW GAS ENGINES
I
J
G
H
F
D
C
B_2
B_1
A
Fce. #6
Fce. #5
Stoves
Stoves.
DUSQUENE GAS WASHING PLANT
A-downcomer
B-dust catcher #1
B_2 " " #2
C-rough gas main
D-Dusquene scrubbers
F-Primary clean Gas ma.
G-Fans
H-Separators
I-Theisen scrubbers
J-to gas engines

Fig. 15

The general arrangement of the scrubbing towers with water seal valves, inlet and outlet gas piping, etc., is shown in Fig. 16.

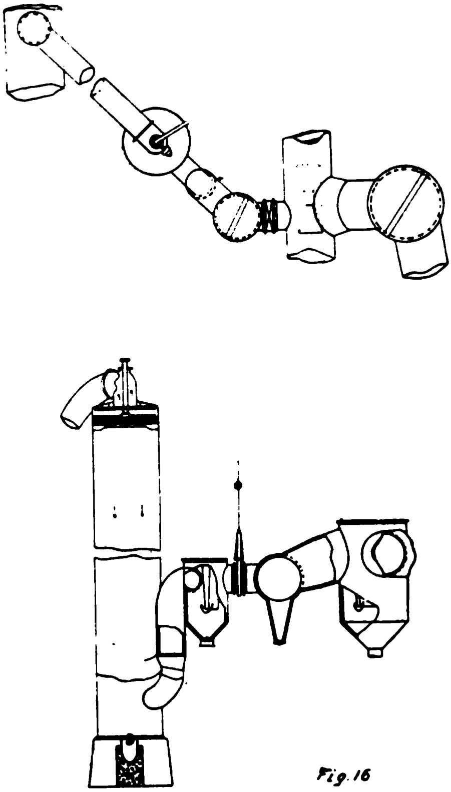


Fig. 16

In Fig. 17 the general arrangement of the fans with water separators on inlet and outlet and the pumps collecting the drainage of the three is seen. The construction of the centrifugal

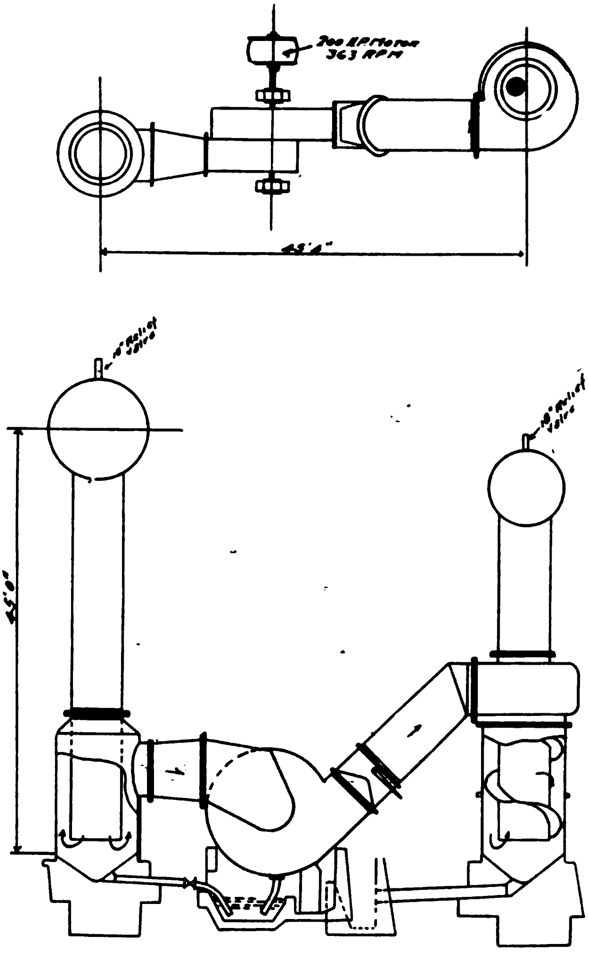


Fig. 17

water separator is also well shown. Fig. 18 similarly gives a good idea of the arrangement of the Theisen washers and the final separator.

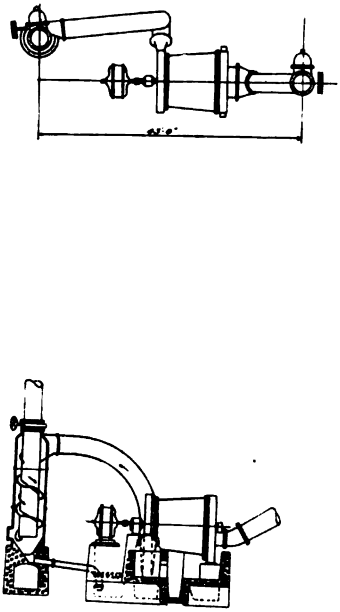


Fig. 18

It was originally planned to pass all the dirty discharge water from the towers through a settling basin to allow precipitation of the sludge and then filter. Filtration was found too expensive, however, and abandoned. A grab bucket and an overhead crane remove the sludge to cars.

The velocity of gas in the scrubbers is about 175′ per minute and the quantity of water used in these towers about 26 gallons per 1,000 cu. ft. cleaned.

McKeesport

The McKeesport Works of the National Tube Company has in operation the secondary cleaning plant shown in plan by Fig. 19. Preceding this apparatus is a preliminary dry cleaning plant located alongside each furnace. The gas is first conducted to a settling chamber type dry cleaner, the gas entering at top and centre and leaving on the side close to the top through two outlets 180° apart. From each of these outlets the gas is delivered directly into a second settling chamber of similar construction except that the course of the gas in reversed, entering at the side and leaving by th top. The first catcher is 25′ in diameter by 40′ high and the second two of the same diameter but 5′ lower. The one of these two smaller chambers supplies gas to the stoves, the other to the rough gas main connecting to all four furnaces. The rough gas main (1) of Fig. 19 delivers to a centrifugal dust catcher which in turn delivers to a second which is a duplicate of the first. These catchers are 35′ in diameter by 35′ high. Two Zschoche washers take the gas next and discharge it to a peculiar "hydraulic main" (2) consisting of a steel plate conduit of an inverted "U" shape the open edges dipping into a water seal, thus forming a safety valve to prevent bursting the apparatus in case of an explosion. From here the gas can be taken either through another Zschoche washer (10) and into the Theisen washer or the Zschoche can be by-passed and the gas sent direct to the Theisen.

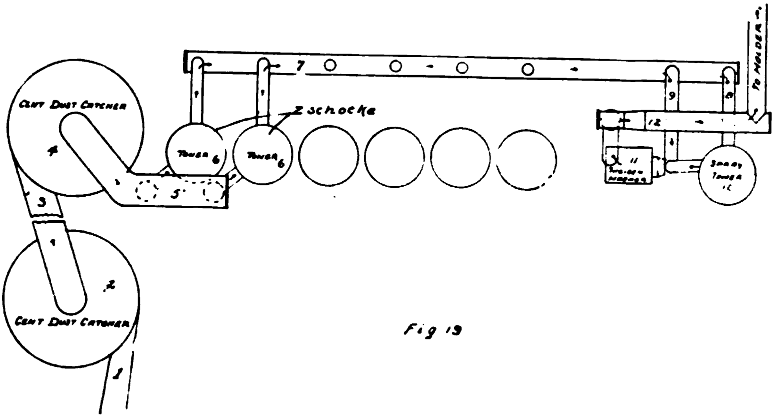


Fig 19

The three Zschoche towers are 14′ in diameter by 40′ high and of practically the same detailed construction as those at Edgar Thompson Works. The series operation of the towers has been found unnecessary. The maximum velocity of gas through the scrubber is about 175′ per minute and the quantity of water about 65 gallons per 1,000 cu. ft. of gas.

South Chicago

The Illinois Steel Company has at their South Chicago plant the gas cleaning plant shown in general plan in Fig. 20. It is

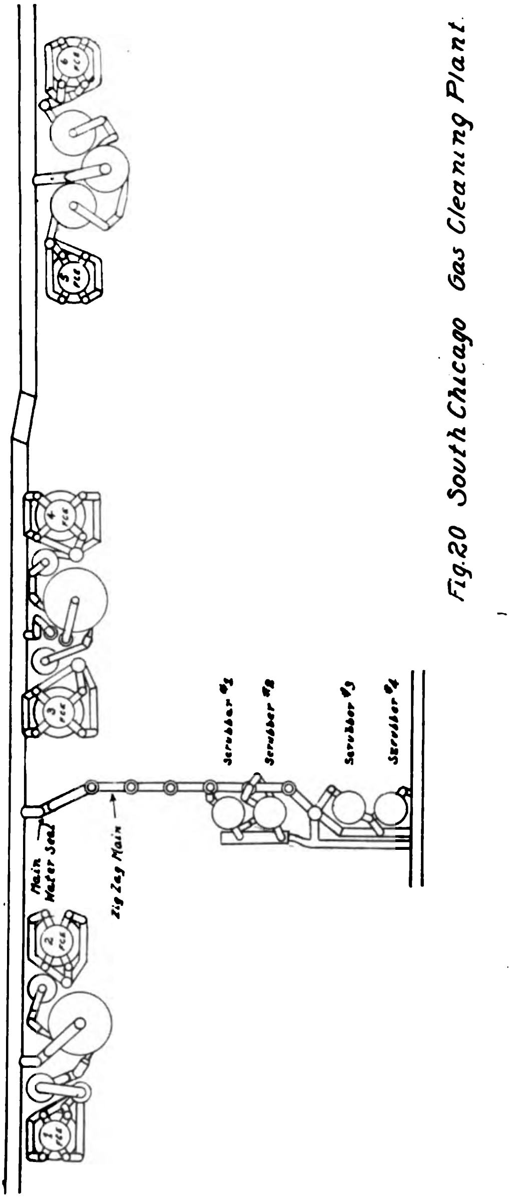


Fig.20 South Chicago Gas Cleaning Plant.

seen that for each group of furnaces there is a group of three dry dust catchers. Each of the outside ones takes gas from the nearest furnace and discharges it into the middle one which delivers to the rough gas main common to the six furnaces. Water seal valves are located to isolate each furnace from the cleaning system. These dry dust catchers are of various sizes and details of construction but the final one of the No. 1 and No. 2 furnaces and all three of the other two groups are of the centrifugal type. The small ones at furnaces No. 1, No. 2, No. 3 and No. 4 are roughly 18 feet in diameter, while the large ones in the middle are 40 feet, and the three at furnaces No. 5 and No. 6 are approximately 28½ feet.

The scrubbing towers are four in number and all of the Zschoche type. The grid arrangement is practically the same as that already described in connection with the Edgar Thompson plant. The water distribution in use is novel. An open tank on top of the tower delivers water through distributing pipes to 36 cylindrical nozzles 1″ in diameter. About 8 feet below each nozzle is suspended a "spray plate" onto which the water jet strikes at considerable velocity and is effectually broken up into drops. About 3½ feet of the falling distance is within the tower. These four towers are each 22 feet in diameter by 60 feet high. The piping arrangement allows of the towers being operated all in series, all in parallel, or two groups in series of two towers in parallel. It was found soon after starting the plant that the four towers operating in parallel gave the best results. The fiinal cleaning is accomplished by Theisen washers.

Gary

At Gary, Indiana, the Indiana Steel Company put into operation on furnaces 9 to 12 inclusive, the cleaning plant given in plan by Fig. 21. Two downcomers (1) taking gas from the furnace top at four points deliver tangentially and at an angle of about 45° off the horizontal to (2) a dry dust catcher chamber at about 1-3 way up from the bottom of the cylinder, the cylinders being 25 feet by 40 feet high. Gas leaves at the apex of the top cone and enters (3) a second similar chamber of the same type as the first except that it is smaller, being 18½ feet by 30 feet high.

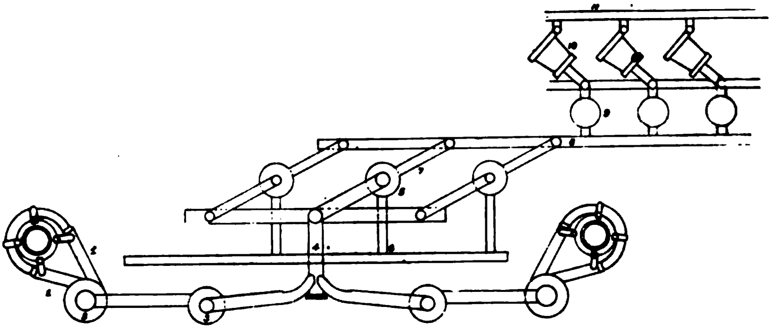


Fig 21-Gary Cleaning Plant

Thence it passes into a main (4) which is common to two furnaces and is delivered to (5) a group of three impinging washers of the Mullen type. These washers deliver into (6) a main supplying the stoves and into (7) a main connecting onto the rough gas main (8) which is common to all furnaces. Gas from this main then enters the base of the wet scrubbers (9) and passes from the outlet at one side near the top to the Theisen washers (10) and thence to the gas engines, via of the clean gas main (11). The scrubbing towers are sixteen in number for eight furnaces and are 60 feet in height by about 18 feet in diameter. These towers are novel in that the lower half is a baffle scrubber and the upper half a Zschoche of standard construction. Koerting nozzles are used as distributors.

Steelton

The plant of the Pennsylvania Steel Company at Steelton consists of a single type of apparatus for each of the three cleaning stages. For the first stage a centrifugal dust catcher is used; for the second, two similar sprinkling towers; for the third, a

Theisen washer. The plan of the cleaning plant is given in Fig. 22. The gas travels from (A), the downcomer from No.

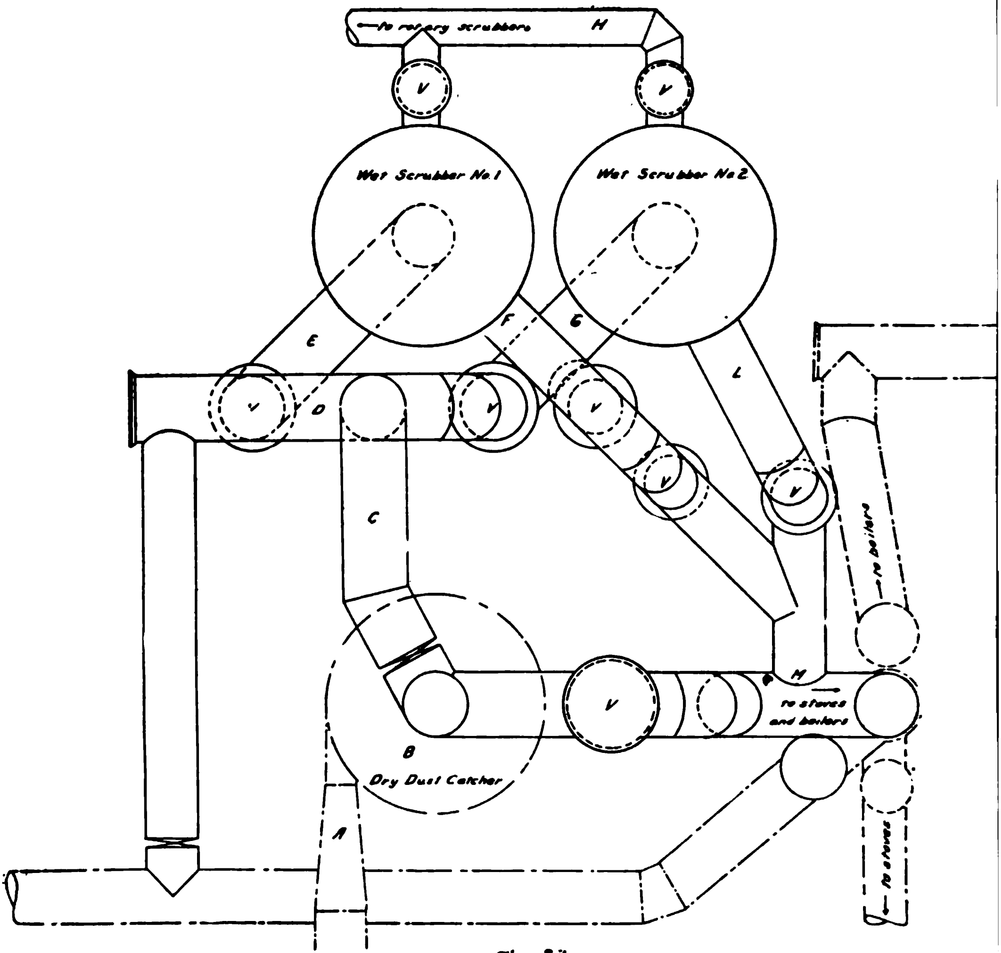


Fig. 22.

3 furnace into (B) the centrifugal dry dust catcher, and through gas mains (C) and (D) to inlet pipes (E) and (G) of wet scrubbers Nos. 1 and 2 respectively. Leaving these scrubbers the gas may be taken off at one side through (H) to the Theisen or through (F) and (L) to the gas main (M) supplying stoves and boilers. An alternative course is provided from (E) through wet scrubber No. 1 out at (F) thence to (G) and through scrubber No. 2 to (H) or to (L). The wet scrubbing plant may be bypassed to get raw gas to the stoves and boilers. The valves (V) are all water sealed. It is seen that the scrubbers may be operated in series or in parallel.

The dry dust catcher is 35 feet in diameter. The scrubbing towers are each 25 feet in diameter by 60 feet high. The sectional elevation is given in Fig. 23. Gas enters through the brick-lined flue (A) impinges upon the water surface (B) passes up through the tower (C), meeting there the rain descending from the distribution above and leaves at (D) or at (E). The gas

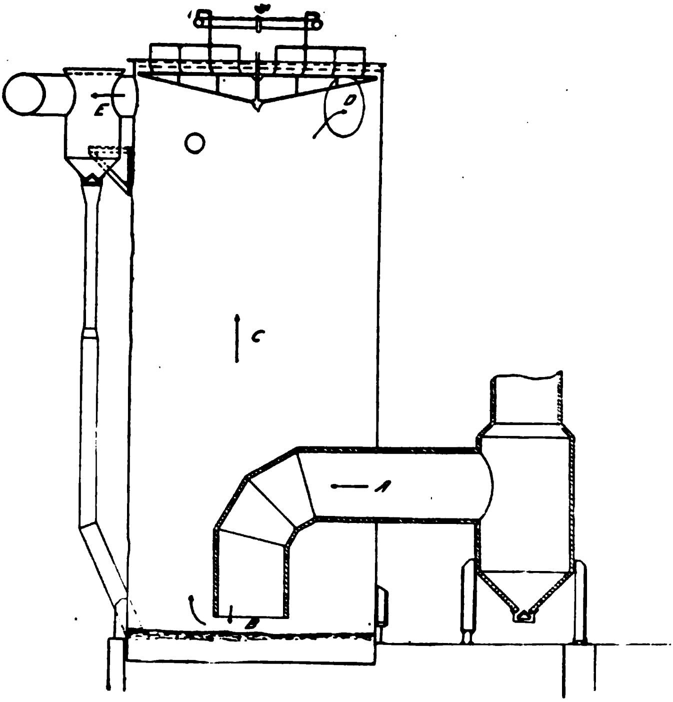


Fig. 23

flues and the dry dust catcher are brick lined as far as the towers in order that the gas may arrive at the tower as hot as possible. The hot gas immediately upon impinging upon the water surface gives up a portion of its heat to evaporate water which is condensed by the rain from above. When this evaporated water is condensed from a gas to a liquid it necessarily passes through a state when the water particles are smaller than the dust particles carried by the gas and will attach themselves to the dust particles in condensing, thoroughly wetting them and weighing them down. In this condition they are readily washed out by the rain through which they are compelled to pass in ascending the tower. The distributor used in this tower for distributing water has been described in connection with Fig. 6.

A study of these eight plants reveals the fact that the cleaning process in each is accomplished in three well defined stages: First, the dry cleaning in stationary apparatus; second, wet scrubbing in stationary apparatus; third, wet scrubbing in rotary apparatus. In the following tabulation is given a synopsis of the plants described with the power and water requirements, the power requirements being exclusive of that to the Theisen washers which are common to all except Buffalo.

	Dry cleaning stage.	Wet scrubbing stage.	Rotary scrubber stage.	Power in K. W. hrs. per 1,000 cu. ft. clean gas, exclusive of power to Theisen.	Water used excluding Theisen in gals. per 1,000 cu. ft. gas.
Lackawanna at Buffalo.	Settling chamber (centrifugal dry dust catcher in remodeled plant.)	Koerting spray towers.	Centrifugal fans.	(Figures not available.)	(Figures not available.)
Edgar Thompson.	Two settling chambers in series.	(1) Spray towers. (2) Centrifugal fans. (3) Baffle washer. (4) Zschoche washer.	Theisen washers.	0.217	83
Carrie Furnaces.	Settling chamber.	(1) Impinging washer. (2) Baffle washer. (3) Centrifugal fans. (4) Zschoche washer.	Theisen washers.	(Figures not available.)	105
Duquesne.	Two centrifugal dry dust catchers in series.	Spray towers.	Theisen washers.	0.0064	26
McKeesport.	Two settling chambers in series. Two centrifugal dry dust catchers in series.	Zschoche tower.	Theisen washer.	None.	65
Gary.	Two centrifugal dry dust catchers in ceries.	(1) Impinging washer. (2) Baffle scrubber. (3) Zschoche tower.	Theisen washers.	None.	(Figures not available.)
South Chicago.	Two centrifugal dry dust catchers in series.	Zschoche tower.	Theisen washers.	None.	63
Steelton.	Centrifugal dry dust catcher.	Spray tower.	Theisen washer.	0.0018	25

The greatest complication exists in the second or wet scrubbing stage, where from one to four types of apparatus are found in a single plant taking from 25 to 105 gallons of water per 1,000 cu. ft. of gas. As a rule the more complicated types of plant are either cleaning gas below the requirements for stove and boiler service or the scrubbers are very wasteful of water. Experience at Duquesne and Steelton has proven that a single scrubbing tower with proper water distribution will clean gas to contain not over

0.15 grains of dust per cubic foot at an expenditure of power of not over 0.0035 K. W. hour and of water of not over 30 gallons per 1,000 cu. ft. Theisen washers average a consumption of 0.1 K. W. hrs. and 7.5 gallons of water per 1,000 cu. ft. of gas. With power at 1c per K. W. hour and water at $10.00 per million gallons a modern plant should clean gas for use in gas engines for 0.14c per 1,000 cu. ft. exclusive of amortization and labor charges.

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A SUCCESSFUL VOLUNTARY JOINT MUNICIPAL ENTERPRISE.

BY ALEXANDER POTTER, Member.*

It gives me pleasure in response to a request from the Board of Editors of the Journal, to endeavor as briefly as possible to set forth a few of the most salient elements which have made possible the success of so notable an achievement as the Joint Outlet Sewer for eleven municipalities in the Counties of Essex and Union in the State of New Jersey.

A discussion of this joint enterprise may be of interest at this time because of activities throughout the country in connection with additional water supplies, sewerage and sewage disposal schemes, park systems, and other enterprises, which, following the general trend and spirit of the age, contemplate the concerted effort of a number of municipalities, and which cannot be successfully and economically consummated without this combined action of the several towns conveniently located for the purpose. Thus, water supplies which must be brought from far distances and which will involve too great an expense for an individual town can often be secured by the joint effort of several towns working together. Park and boulevard systems advantageous to a number of municipalities can be shared in by all and add greatly to the attractiveness of the locality in which they are situated. Many improvements are thus made possible by a combined effort which would not be within the means of an individual town.

Especially are the advantages to be secured by combination evidenced in relation to sewage disposal: Suburban towns in particular finding it especially difficult to procure suitable disposal sites within their own limits without creating a nuisance or depreciating to a certain extent the value of the property in the vicinity of the disposal plant. Nor can a town of such character expect its neighbor to sit patiently by while sewage is being dumped upon it or a disposal location sought by another town to its detriment.

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Such situations are arising more constantly now than in the days when our population was more sparce, and many conflicts, litigations, or delayed improvements have become the ever increasing results. By combination, however, an outlet, either to tide water or into some larger stream or body of water, or some district less habited, where proper purification can be installed without great damage to surrounding property, can be secured by an outlet sewer at a small percentage of the cost of constructing or maintaining a proper disposal at or near the individual towns themselves, much expense and many difficulties being thereby eliminated. Joint effort along these lines permits also the perpetuation of the individuality of the towns and that civic pride which means so much to the American commonwealth.

Probably no one factor stands so strongly in the way of these advantageous joint enterprises as the question of the just apportionment of cost and maintenance among the interested communities. It will therefore be of interest to know how eleven municipalities, differing widely in forms of government, size, area, wealth and situation, succeeded in voluntarily uniting and carrying to completion, and for seven years satisfactorily maintaining without one protest, or any dissatisfaction or discord, an enterprise of the character of the Joint Trunk Sewer. A discussion of the salient elements in connection with this joint sewer will be the more interesting, because up to the time of its construction, no other joint enterprise between municipalities has been consummated upon the basis of apportionment which was adopted in this case. Probably to this method of apportionment, more than to any other one factor, is due the almost phenomenal expedition and great satisfaction with which it was put through—an expedition and satisfaction we are safe in saying unequalled by any other joint municipal enterprise before or since achieved and characterized throughout its preliminary arrangements, its entire construction, and the seven years of its maintenance, by a harmony, liberality of spirit and unity so complete, that not one discordant note or a single litigated feature has marred the enterprise from start to finish. Other joint enterprises, completed before this was begun, but based upon different methods of apportionment, are still discussing and protesting against inequalities and injustices of apportionment between the interested municipalities. Other joint schemes which were being discussed before this enterprise had its inception are still in the unconstructed stage and as far apparently from actual achievement as they ever were, all because a proper basis of apportionment is still the question at variance.

If, therefore, a brief description of this Joint Trunk Sewer and its method of apportionment, which has proved so fair, just, and satisfactory as a *workable proposition*, will afford any assistance to such municipalities as may be wrestling with this difficult problem, or add anything of merit to the literature of the subject, the author will consider himself well repaid.

History

As early as the year 1898 the author was engaged as consulting engineer to devise some means of providing sewage disposal facilities for the municipalities of the Village of South Orange, West Orange Township, South Orange Township, Vailsburg, Irvington, Millburn and Summit, New Jersey, together with that portion of the City of Newark which drains away from the Passaic River. A number of these municipalities represent the highest type of suburban property in the vicinity of New York. They had for years been struggling with the problem of local disposal of their sewage and none had reached a satisfactory solution, although one of them had already built and maintained for some years a local disposal plant. Another had purchased a site for a disposal plant in an adjoining township, on the familiar principle that while there is no nuisance in a sewage disposal plant, it is safer and more desirable to have it well away from ones own premises and to put it on the land of the other fellow. So it had sought a site in another township, and after construction was commenced an injunction prevented its completion. At the time the author was called in, the question of reaching tidewater with the sewage of certain of these towns had been previously discussed, but no feasible solution has been found.

After exhaustive study and investigation, a solution was found in a gravity outlet at Staten Island Sound, and the details of design, construction, costs and apportionment were taken up. While these details were being worked out many changes were from time to time necessitated because of the application of new municipalities, not previously interested, to join in the combined system. This entailed great labor and many readjustments, for while the Joint Trunk Sewer was originally designed to care for the sewage of a number of inland cities, it now serves as an outlet for the sewage of the City of Elizabeth, (excluding Elizabethport), the Borough of Roselle Park, the Township of Union, the Towns of Irvington and West Orange, a portion of the City of Newark, a portion of the City of Orange, the late Borough of Vailsburg, (now a part of Newark), the Village of South Orange, the Township of South Orange, including Maplewood and Hilton, the Township of Millburn, which includes Short Hills, Millburn Village and Wyoming, and the City of Summit.

Each of these municipalities is connected with the outlet at Arthur Kill, a body of tidal water separating Staten Island from the mainland of New Jersey, by a trunk sewer and its various branches, which in turn unite with a great network of lateral sewers covering an area of some 50 square miles. The trunk sewer runs in a generally northwesterly direction from its outlet. It is 72-inches in diameter at the outlet, and gradually diminishes in size until at the ends of the various branches it varies in size from 10-inches to 24-inches in diameter. The trunk sewer proper is twenty-three (23) miles in length and cost approximately $813,000.00. This does not include approximately two hundred and fifty (250) miles of main and lateral sewers tributary to the joint trunk sewer.

While there were many interesting engineering features in connection with the design and construction of the joint system, they were most of them such as have been successfully handled on other notable engineering works and cannot be included within the scope of this paper. Reference should be made to one, however, because it shows the spirit in which this great enterprise was conducted for the general welfare.

The system as designed included the construction of a tunnel three-quarters of a mile in length and 38 inches in interior diameter. It was found that its entire length would have to be laid through quicksand and that in the construction it would be necessary to resort to the use of compressed air. The contract called for the construction of a 38-inch sewer, but when, after many unsuccessful efforts to lay the sewer by ordinary methods, it was found necessary to resort to compressed air, the Commission thought best to increase the size of the sewer to 48 inches in diameter, and an allowance was made to the contractor, over and above his bid, of an amount equal to the increased carrying capacity of the 48-inch sewer over the 38-inch sewer, and the 48-inch sewer was successfully constructed. The 38-inch sewer would have cost the contractor fully as much as the 48-inch sewer, but to hold the contractor to the strict letter of his contract would have financially embarrassed him and caused delay and litigation. Therefore the Joint Meeting, representing the combined municipalities, deemed it prudent to adopt this liberal policy, having as its *quid pro quo* the lengthened life of this portion of the sewer and the speedier completion of the project.

This sufficiently illustrates the general policy of fair mindedness on the part of the Joint Meeting that characterized the entire work, not only in the relations and difficulties arising between the Joint Meeting and its contractors, but also in all matters between the different municipalities themselves, and as regarded dealings with outside municipalities, corporations and individuals. Such a course it will be admitted is unusual, especially when we remember that there was no law compelling any one of these municipalities to join in the enterprise or accede to any particular course. It might be urged that such a liberal policy would materially increase the cost of the construction. But on the other hand the evidence is that the total cost of the sewer, considered on the basis of per capita served, area drained, or size of sewer, was less than similar constructions in other parts of the country. Comparing its cost with work done on the metropolitan sewer in and around Boston, we have the written opinion of the Chief Engineer of the metropolitan sewer district that the cost of the joint trunk sewer was less than similar work done upon that important sewerage system.

One of the important results of this liberal and rational policy was undoubtedly the saving of much time. A similar project. involving the same general conditions and similar territory, but covering a larger area and a greater expenditure of money, was being agitated several years before this joint sewer project was even thought of, but it has not yet reached the construction stage; while so successful and satisfactory has been the installation, apportionments and operation of this joint project, now over seven years completed, that one scarcely hears of its existence save in the municipalities so adequately served. Twice a year the payments have been regularly met without a protest of any kind from any of the interested municipalities, while the advantage of the use of the sewer through all these seven years can hardly be estimated, the towns have so wonderfully increased in their population and in the value of their real estate.

Furthermore, most of the present officials have been identified with the project from its inception to the present time.

The Outlet.

Perhaps the storm center of the future in connection with all sewers emptying into and around New York Harbour will be their outlets. With the fact in mind that all cities might sooner or later find it necessary to subject their sewage to some form of treatment before discharging their contents into any of the waters of the State, the joint trunk sewer system was so designed that treatment can be applied when necessary without materially affecting the construction of the sewers themselves.

With a view to determining the amount of pollution from this sewer, investigations are made from time to time to determine the effect of the discharge of this volume of sewage into the Arthur Kill, the average flow amounting to about 5,000,000 gallons per day at the present time. It is rarely possible, however, to discover with the eye any trace of the sewage from this outlet for more than one hundred feet from the mouth of the sewer.

The original plans for this sewer contemplated the carrying of the sewage to the middle of the stream and its discharge through numerous openings into twenty feet of water. The City of Elizabeth, whose territory the sewer traversed for a distance of over three miles, petitioned that the plans be modified to discharge the sewage at the bulkhead line, and that the amount of money thus saved be expended on the construction of a wharf for public use at the end of the sewer. This request was acceded to.

Apportionment of Cost.

The most important subject to be discussed in connection with this joint project is, as we have said, the apportionment of the cost of construction and maintenance. The task of convincing aggregations of people, each with divergent interests, of the wisdom of undertaking certain public improvements conjointly is a difficult one. To secure a written agreement between these same people, providing for the payment of such public improvements by a plan that will be acceptable to each as being both just and equitable to all concerned is more difficult. It requires but a brief investigation into the various plans adopted throughout the country, where systems of parks, water works, sewerage, etc., have been constructed conjointly, to realize that in nearly every case reasonable objections have existed to the plan of apportionment suggested or enforced.

When requested, as Chief Engineer of the joint trunk sewer, to investigate and report upon some method of apportionment which would be fair and just to all concerned and which would be acceptable to all the communities thus voluntarily combining, the author was not inappreciative of the confidence which had been reposed in him nor of the difficulties which confronted him: difficulties which at the time seemed well-nigh insurmountable. The few instances of combined action on the part of municipalities were hardly parallel cases or instituted under like conditions, and while each and all were thoroughly investigated, they offered but few suggestions applicable to the case in hand and formed no precedent in the consideration of the problem before him. Moreover, none of the various methods of apportionment thus far adopted had proved wholly just. The field was therefore broad and fallow for the attainment of more perfect and equitable methods.

Up to the year 1875 the cost of construction of public improvements in New Jersey had been assessed upon all property bordering upon the said improvements according to its foot frontage thereon. This had worked the greatest injustice, notably in the cities of Elizabeth and Newark. Since 1875 the courts of New Jersey, in what is known as the "Agens Case" and following decisions, have departed from their former precedents and have declared that the element of *special benefits* should qualify the amount of assessments charged against property owners for public improvements, and that "the assessment to be valid must be laid proportionately according to the benefits conferred and not in excess thereof; and hence that assessments of the entire cost of improvements made upon adjoining land 'by the lineal foot' or otherwise, without regard to the particular benefits each lot received, were unconstitutional and void."

Believing that the same principle should be applied to an aggregation of individual municipalities that was applied in municipalities to the individual himself, and taking the spirit of this law for his fundamental finding, the author began his investigation as to the weight to be given the various elements which might be considered as entering in the determination of a just apportionment, such as

Area,
Valuation,
Population,
Different bases combined,
Water Supply,
Use, etc.

As it may be helpful to show the line of reasoning by which conclusions were reached, the author will endeavor briefly to set forth the arguments, drawn from his investigations, for and against the use of these different elements as bases of apportionment.

Area.

It must be acknowledged, even from a most superficial study, that area in itself is absolutely useless as a proper basis of apportionment, because area, apart from use, means nothing. On this basis, also, it is evident that a town, village or township which has much of its territory made up of marsh lands or steel hill sides should not be assessed for sewers on the same basis as districts which are more favorably situated and can reasonably expect a large increase of population in the future. Oftentimes, also, the greater the area of certain suburban districts, the larger the subdivisions of individual owners and therefore the less need of the individual properties contributing to the sewers, as cesspools or private disposal grounds are far less objectionable than in closely built up districts.

Area, therefore, can only be considered when a detailed examination has been made o fall the lands within the territory to be drained, and then only when there is some qualifying factor which might be used as a check to the correctness of the conclusions reached by this determination. For instance, in the investigations made it was found that upon the basis of area, included in the combined district, Newark and Vailsburg, the two municipalities promising the greatest growth and the most imperative need of the benefit of sewerage, would bear but 2.2 per cent. and 6.2 per cent. respectively, while the district most sparcely settled and the least likely to rapidly increase its need or use of the sewer would have to bear 29.3 per cent. of the cost.

In considering an element which admits of so much variation in getting at a true apportionment, it is hard to see how the question of area in itself can be utilized even as a factor in the determination of the relative amounts to be paid by municipalities contemplating the construction of a joint trunk sewer.

Valuation.

Perhaps the most convincing arguments possible to be advanced in support of any one basis of apportionment can be brought forward in favor of valuation. This was the basis adopted for the apportionment of cost of the metropolitan sewerage system, a system designed to relieve bad sewerage conditions in the numerous cities and towns within a radius of ten or fifteen miles around Boston. This system was paid for by the issuance of fifty year bonds, the legislature providing that the interest and sinking fund should be met by an assessment against the various municipalities, to be reapportioned once every five years by three commissioners, who were to be non-resident of any of the cities or municipalities within the limit of the area to be drained.

The arguments which can be presented in favor of assessed valuation as a basis of apportionment of the cost of a joint sewerage enterprise are, briefly stated, the following: that health being wealth, the protection of health is the protection of wealth, and that therefore the improvement should be paid for upon a basis of wealth, or, assessed valuation alone; that as all national, state, county, or municipal taxes are based on valuation, then why should not sewers be paid for upon the same basis; that apportionment upon the basis of valuation is one easily understood, simple, and established upon a fixed principle and not upon theory or guesswork; that valuation gives us a law of apportionment that is as near as may be just and one which is stable and not subject to change; that as it is our right not only to guard and protect our own home and town, but also to insist that our neighbor and surrounding and adjacent municipalities have sanitary arrangements which shall keep the air as pure as science can procure, it should also be our duty to help pay for such a condition, and hence that wealth should help to pay for such a privilege an even greater proportion than the personal share of the individual or his proportionate share of the use of the sewers; that as sewerage being a health measure makes property more valuable, values should, in the last analysis, pay for such improvements.

While these arguments were advanced with much force before the various commissions in Massachusetts, the principle was much more applicable there than in the case of the joint trunk sewer of New Jersey, first, because all the towns in the metropolitan system were older and had more nearly attained what might be termed their normal growth, and, second, because the law authorizing the construction of these sewers provided for the issuance of fifty year bonds and the readjustment of the apportionment once every five years. Two conditions not applicable to the joint trunk sewer enterprise.

The method of basing the apportionment upon valuation, while received with general favor by the cities in the metropolitan sewerage district, nevertheless worked great hardships upon many of the towns in that district which were forced by legislative enactment to become a part of the district on account of their location, although some of them had better sewerage facilities, as far as they themselves were concerned, then they now have under the metropolitan sewerage system, while the cost of operating their own systems was small compared with the charge upon them under the combined system. As, for example, the town of Somerville, Mass., contributing annually as it did for five years the sum of $25,000.00 to the cost of the combined system without having any connection whatever with the system towards which it was contributing this large amount. Another example being the town of Winthrop, which had just completed a system of sewers at great cost, and the outlet for whose sewers was not far from the proposed outlet for the combined district. Yet because the main trunk of the metropolitan system was designed to pass through their town, legislative enactment compelled this town to abandon its own gravity outlet, pay its share in the cost of constructing sewers to carry off the sewage of twenty inland towns, and pay its full proportionate share of the cost of pumping the sewage of these towns three times; notwithstanding the fact that by its own system the sewage of the town flowed by gravity into the sea.

The commission for the metropolitan sewers had it in their power to make an exception where such evident hardship was being inflicted and not apply the general law of assessment by valuation, but so great was the tenacity with which the commission clung to the established precedent, that no deviations were made in any case, not even in favor of the town of Winthrop.

Such a course might be followed in Massachusetts, where, as we have stated, the law gave them the right to enforce such conditions even to the working of great hardship. But such a principle would hardly have been acceptible to the New Jersey communities, where, as we have stated, there was no law to sustain or compel the entrance of any municipality into this combined system. The municipalities about to engage in the joint sewer enterprise were doing so of their own free will and volition, and would certainly have accepted no basis of apportionment which appeared to them unfair.

A strong argument against apportionment on the basis of valuation is undoubtedly the fact that there are almost infinite variations in the method of making assessments or estimates of valuation; some towns having a high tax rate and a low assessment value, and others, wishing the opposite condition to exist, having a low tax rate and high valuation. Moreover, the towns which would be the most greatly benefited by the introduction of sewers and receive in consequence the greatest accession of growth, might be those which in the beginning would perhaps contribute the least assessible value. In other words, inequalities in the characters of the towns interested makes the determination of apportionments on the basis of valuation an extremely hazardous one.

Population.

If the apportionment be distributed on the basis of population the amount assessed is charged to the city in a lump sum, turned over the tax collector and collected, *not per capita,* but according to amounts assessed against all the property of the city. It is, therefore, not a per capita tax, but resolves itself into a tax on assessible property. As the assessed valuation in one city might be half as high as that of another, where the population is perhaps the same, the individual in the town having the lower valuation will be compelled to contribute twice as much towards the construction of the sewer as another individual in the town having a greater valuation.

It is of interest to note that while the commission of 1891 and 1895 of the metropolitan district decided in favor of valuation as the basis of apportionment, a previous commission in 1885, appointed before the question of cnnstruction had been definitely settled upon, decided in favor of population as a basis.

Different Bases Combined.

So much difficulty has been experienced by various Boards in securing a basis of apportionment which would work absolute justice to all parties, that attempts have been made to work out the inaccuracies in any one method by combining several of these different bases of apportionment and by taking the mein of all or several of them to secure a just apportionment.

The Metropolitan Park Commission of Massachusetts adopted a basis of one-third for population, one-third for valuation and one-third for what is known as "special betterments."

The Metropolitan Water Board assessed two-thirds according to population and one-third according to assessed valuation.

While this method of combining elements is perhaps more nearly accurate than that of valuation alone, or of area alone, or of population alone, it is still impossible to follow this method unless certain factors can be determined. The population estimated by these Massachusetts Boards were arrived at by finding the increase in growth in population from previous census reports and a forecast made therefrom, but even this was demonstrated to be inaccurate. When, therefore, towns are comparatively new and census reports are not obtainable for any long period of years an even greater element of uncertainty exists.

System of Actual Use.

From his investigations the author was able to deduce certain general principles, which may be expressed in concise form, as follows:

First, that approximation and not scientific exactness is the only result that we can hope to obtain or that has ever, in view of the demonstrated facts, been obtained by any method.

Second, that all individual methods are subject to insuperable difficulties.

Third, that the object to be attained is the securing of an apportionment which is as near as may be just, equitable and generally acceptable, which is reasonably stable and not subject to changes, but at the same time one which might not be over-turned if carried into the courts.

Fourth, that the method should, if possible, be simple and easily understood, and established upon some just and equitable basis and principle.

Fifth, that the method should be such as to need no revision if the apportionment is to be paid in one payment, as discrepancies and injustices appearing at a later time cannot be rectified.

Sixth, that the method should be based, not so much on "scientific demonstration, but on sound judgment and common sense."

Seventh, that the whole matter should be approached with the spirit of fairness and compromise if necessary.

Use.

Bearing these principles firmly in mind, it will be agreed that it matters not what the character or condition of a people in a community might be, if they use the sewers they should pay for that use in the measure in which they use them. In the various water supplies throughout the country, payment for water is not based upon the ability of people to pay, or whether one community is richer than another, or whether one is benefited more than another, but upon the amount of water used by each. Should it not be the same with sewerage facilities?

It was found that in the discussion before the various commissions appointed to apportion the cost of various enterprises, one notable fact had always been present, viz.: that while certain factions advocated valuation as a basis, and certain others population, and still others a combination of these and other elements, all agreed that in the last analysis the only true method of apportionment was upon a basis of the determination of the amount of sewage contributed by each town, but on account of the difficulties of such a determination, a practical application seems not to have been made, although the principle was admitted as fundamental.

This method, however, seemed ideally fitted for application to the Joint Trunk Sewer of New Jersey; the more so, because there were no sewers already built in that district for the accommodation of both storm water and sewage, and the vital question of imperfect construction of existing sewers was also largely eliminated. In the metropolitan sewerage system some of the towns contribute to the main trunk sewers six times the amount of water which should be the measure of their use, showing conclusively the enormous quantity of leakage, due to imperfectly constructed sewers or to systems formerly designed to accommodate storm water as well as sewage.

Basis of Apportionment Recommended and Adopted.

The apportionment recommended, therefore, was based upon the amount of sewage contributed by the possible ultimate population of each district or municipality, determined by a detailed examination of the physical characteristics and environments of the various municipalities, and a study of the water supply of each.

Further, that the absolute right should be granted each municipality or district to own, control and dispose of so much of the cubical capacity of the outlet sewer as was proportionate to the percentage of the total cost of the joint outlet which was borne by each municipality or district.

In the enunciation of the method of apportionment adopted, it was agreed that the different municipalities would be entitled to that proportion of the cubical capacity of the main outlet sewer which their percentage of the cost bore to the whole cost; that each municipality had the right to do with this capacity what it pleased, either to use it, sell it or otherwise dispose of it as best suited themselves. In other words, each municipality gets exactly what it pays for; can use it in any manner it pleases up to their own individual limit of capacity; or can sell or dispose of it if it so chooses.

In the plan adopted each town determined the quantity of space it would require, and in the joint trunk sewer each owned this much space just as sacredly as if it had built its own outlet sewer to tide-water. Each town assumed responsibility for the quantity needed to meet its future requirements. The combination with other towns gave it this advantage; that if in the course of years this allotment was found to give one town more than it needed, or another town less because of its rapid growth, an exchange could be effected and the financial operation transacted in a similar manner to the purchase or transfer of land. That the measurement of sewage flow can be made continuous and with accuracy has been proved beyond the peradventure of a doubt.

The justice of this method of apportionment should, therefore, appeal to all, as it is based upon the sound business principle of "value reecived," not in theory, but by actual possession. The paying for each proportionate share in the joint trunk sewer was like purchasing shares in a joint stock company whose value could never drop below par, but which will have an ever increasing value and will be eagerly sought after. That this is true has been already proved.

It will be seen that there entered the element of population as it related to ultimate USE. In order to obtain the ultimate possible population, access was had as far as possible to the existing and proposed sub-divisions of the territory included within the limits of the district, to determine the intention of the owners of these tracts as to the use to which the land would be put. Land not so laid out was examined for the purpose of determining the possibility or probability of its use for dwelling-house lots, and the land adjacent to built-up districts was examined with the purpose of ascertaining, as nearly as might be, the ultimate population of each district provided the class of house already existing should continue to be the style of house built and occupied in the future. Of course such a calculation will give results far in excess of any population likely to be seen within the life time of any living, and was about double that estimated or allowed for in designing the size of the main outlet sewer.

The question of water supply had also to be determined as being an important factor and having an important bearing upon the subject. Newark, for instance, had a free and inexhaustible supply with a per capita consumption over the entire city of 130 gallons per day. Irvington's water supply was metered and averaged about 45 gallons per capita per day. Millburn's water supply was extremely limited and amounted to about 60 gallons per day per capita. West Orange's consumption on the other hand was large. All these differences were given due consideration.

While this was a voluntary combination, it was a noteworthy fact that only one municipality which originally contemplated entry failed to join in the enterprise before construction was begun. It is also a notable fact that the joint trunk sewer had not been in operation one year before this same municipality was seeking to procure from the joining municipalities sufficient space for its sewage disposal needs. Up to the present time this municipality has succeeded in procuring only about one-half of its original estimate of needed capacity, and for that amount has paid one of the municipalities one-half the cost of its entire capacity for parting with just one-quarter of its capacity. In other words, the joint trunk sewer since its construction, as proved by actual purchase has doubled in value.

The officers of the town who refused to join in the joint trunk sewer enterprise at its inception have received the severe censure of their constituents. Furthermore, on account of this town's extremely limited capacity in the sewer, it is costing the town about 20 per cent. more for the construction of its laterals, because precautions have had to be taken which will positively prevent the intrusion of ground water into the sewer, and throughout this district such construction is exceedingly difficult of attainment, because most of the sewers must be constructed through quicksand, rock, or water-bearing drift formation where the normal leakage in the sewers, with only ordinary precautions, would not be less than 25,000 gallons per mile,—an amount sufficient to use up in leakage alone fully 50 per cent. of the total capacity which this town has been able to secure from its neighbors in this joint enterprise.

This is the price which one municipality has had to pay for its procrastination. By means of precautions provided by the chief engineer of the joint trunk sewer, sewers are actually being constructed throughout this district, through quicksand and water-bearing drift, with an average leakage of only 400 gallons per mile per day, by actual displacement measurement; an amount so low that the author challenges its duplication on any work constructed in this country under similar adverse conditions of construction.

It may not be generally known that the average leakage in sewers to-day throughout this country, where sewers are subject to the effect of groundwater, is not usually less than 20,000 gallons per mile per day during those seasons of the year when water stands in the ground.

Maintenance.

The measurement of the quantity of flow in sewers is not a difficult matter to secure. This is obtained by means of continuous sewer gauging by means of a Dibble Recording Gauge, housed in a brick chamber, at each of the points where the laterals from the various municipalities are admitted into the main trunk sewer. Several of the municipalities have more than one point of admission of laterals into the main sewer, and in all fifteen continuous gauges have been established and are maintained. Valuable data have been obtained from these gauges as to sewer flow, ground water leakage, maxima and minima flows in sewers and the effect of heavy rains upon sanitary sewers and the time increment of such storms.

Apportionment of Cost of Laterals.

The percentage of cost of each branch of the trunk sewer is determined by apportioning to each the percentage which their apportionment of the main trunk sewer bears to the total apportionment of all those towns or portion of those towns interested in a particular branch.

The relation of the entire cost to each municipality to the final total cost of the joint trunk sewer is not identical, therefore, with the percentage of the capacity of each town in the joint sewer, because of the difference in distance from tidewater and also on account of greater construction difficulties on certain of the sections, the cost of which was not shared in by all the municipalities.

The further the town was removed from the outlet the greater its percentage of cost. It was the recognition of the fact that there could be no discrimination, other than the logical one of location and proximity to the outlet, in favor of some one municipality and against others, and its rational acceptance, that contributed so largely to the harmonious action between the municipalities in the inception of the work. It should be closely observed, however, that while those nearest the outlet pay less than those more remote, the actual difference in the final payments for the same capacity is not so radically different, nor does this principle place so great a burden upon the more remote towns as to jeopardize the possibility of their co-operation in the joint enterprise. Summit and West Orange, the towns at the extremities of the two longest branches of the sewer, pay just 9 per cent. more than they would have paid had the element of distance from the outlet not been considered as a factor in the determination of the problem.

When it is remembered that a proper and effective disposal of the sewage of any municipality forms an essential part in the future growth of the town, and when we further consider that by providing the same facilities for the disposal of the sewage of the remote town as is enjoyed by the towns below, the future growth of the city is not curtailed, a town or city so situated should feel no hesitancy in paying the slight excess which may be necessary for such a privilege, since its disposal might oftentimes be otherwise of even a more expensive character.

The Laws.

After a preliminary study of the joint sewer project had been made and a satisfactory basis of apportionment adopted, it was found that there were no laws on the statute books of New Jersey enabling towns of various forms of government to join in a joint enterprise, and consequently such an act had to be passed by the legislature.

As is usually the case, however, with such laws, after the essential features of the project have been taken care of, much foreign matter was injected into the law; a logical result of the not uncommon practice throughout the country of compiling laws from those originally prepared for some other purpose and to fit some other condition. A good example of absurdities creeping into laws on account of this careless practice is found in the constitution of the State of Oklahoma, a state far removed from any large body of water, in its provisions, stated in great detail, for an open season for the killing of seals in that state. Thus, the basis law upon which the joint trunk sewer was built was a law four times as long as it should have been because it took up in detail the procedure of assessing special benefits on property through which the joint sewer passed. This portion of the laws was afterwards repealed because it was found to be inapplicable to the peculiar and special conditions arising under this enterprise.

In the history of the joint trunk sewer prepared by the author in 1910, counsel for the joint meeting, Adrian Riker, Esq., at the solicitation of the author, prepared a synopsis of the laws governing the construction, maintenance and operation of the joint trunk sewer. Mr. Riker says:

"The legislative authority for the construction of the joint trunk sewer is found in Chapter 36 of the Session Laws of 1899, being an act entitled, "An Act to authorize two or more municipalities in this state to jointly construct and maintain outlet or trunk sewers."

"The fundamental idea embodied in this act is that of a copartnership between several municipalities for the construction, operation and maintenance of a joint trunk or outlet sewer to serve their common needs. This idea of co-partnership appears to have been adopted in preference to the establishment of a sewerage district to be controlled by a sewerage commission in view of legal difficulties encountered in the past in the operation of such districts by commissions.

"An examination of the details of Chapter 36 of the Laws of 1899 discloses great simplicity in the plan of operation therein embodied. The first step consists in a preliminary agreement by two or more municipalities to pay costs of the necessary surveys, engineering work, maps and plans for the construction of a joint outlet sewer. Upon the submission of the survey, maps and plans so prepared, and the estimate of the proposed cost of the work, authority is given to the several municipalities to adopt ordinances providing for the execution of a contract between them. These ordinances shall describe the route, size, capacity and extent of the sewer, shall contain a description of the main or trunk sewers, if any, to be connected with the outlet or trunk sewer, and shall fix the percentage of the capacity of the sewers to the use of which each municipality shall be entitled, and the percentage of the total cost of the improvement to be paid by each municipality. After the passage of such ordinances by the several municipalities, the act makes it lawful for the proper officers thereof to execute a joint contract in accordance with the provisions of the ordinances, and for every such municipality to do all acts necessary in the execution of such joint contract. It will be noted at once that the fundamental ordinances and the contract to be based thereon deal only with the essential matters of the route, size, capacity, distribution of use and distribution of cost of the sewer, and leave the details of the execution of the work to be determined by the joint meeting of the boards of the several municipalities so contracting which have charge of sewerage matters within their own municipalities. As to details there is therefore left considerable latitude and flexibility so far as the fundamental ordinances and contract are concerned.

After the execution of the contract, the act provides for the organization of a joint body designated in the act as "The Joint Meeting." This is constituted of the bodies or boards of the contracting municipalities having authority to construct sewers and drains therein. The first meeting for organization is held upon notice fixed in writing by a majority of the presiding officers of such bodies or boards in the several municipalities. The meeting when so called proceeds to organize by electing a member of one of the bodies or boards as permanent chairman and by election of a secretary and treasurer who need not be members of any of the bodies or boards constituting the joint meeting. Each of the contracting municipalities is given an equal vote through its board in the joint meeting and a majority of the boards represented in the meeting is constituted a quorum and given power to pass or adopt motions or resolutions. The joint meeting is made the official representative of the contracting municipalities and given power to do all acts necessary to be done under the joint contract for the execution of the work contracted for except in relation to the raising and paying of the moneys provided to be paid by the contracting municipalities under such contract. In this matter of raising and paying money each municipality acts in its separate corporate capacity. Having thus provided for the fundamental contract and for the executive body to carry it into effect by the construction of the joint outlet sewer, the act then deals with certain matters of detail such as the power to acquire land by purchase or condemnation, the right to contract for and acquire a right of way throughout municipalities, the right to contract to grant to other municipalities through which the sewer may be constructed the privilege of connecting its sewers or drains with the joint outlet sewer; there is also embodied in the act a provision for the raising of the necessary moneys by the several contracting municipalities by issuing notes or other temporary obligations, in the first instance, and by the issue of bonds to fund the net amount of such temporary obligations. There is also in the act authority to provide in the original contract for the repair, operation and maintenance and for the cost and expense thereof by the several contracting municipalities.

"In conclusion it can be said fairly that this legislation has the great merit of simplicity and flexibility—a merit put to the test of actual operation by seven contracting municipalities in the construction of a sewer into territory of municipalities not parties to the contract and its point of discharge in such territory—and a merit demonstrated by the fact that so little amendment in essentials was found to be necessary and no litigation arose except condemnation proceedings for rights of way."

The first joint sewer to be constructed under an apportionment based upon use and owned capacity, and the first and only joint sewer to be constructed under the above described act is the one described in this report. The joint outlet sewer voluntarily entered into by eleven municipalities of New Jersey.

UNIFORM SCHEME OF ACCOUNTS AND REPORTS FOR WATER SUPPLY ENTERPRISES.

BY EMIL L. NUEBLING,* Member.

(Being a Digest of the Report of the Committee of the American Water Works Association on the subject.)

INTRODUCTION

The work of preparing such a report is largely one of compilation of the results of a thorough study of the problems involved by others. The time-worn customs of accountants and the advanced views of economists have been taken into account. There are many associations, commissions and public and private bodies interested in the subject of uniform accounts. Public service corporations and commissions, the bureau of census of the United States, the Interstate Commerce Commission, Railroad Commissions, Water Supply Commissions, Water Works Associations and Engineering Associations, Government Accountants and certified public accountants, have an interest in the establishment of uniform principles of public service accounting applicable to all classes of public service.

Works managers and economists and public writers also recognize the desirability of uniform accounts; would-be investors also appreciate the advantages that would accrue from uniform reports based on a system of uniform accounts. And this desirability pertains to both privately and municipally owned and operated plants.

If this uniformity is ever to be obtained, it must be through the universal use of common terms with the same significance. In the discussion which follows, all the terms relating to the accounts of Water Supply enterprises are presented and carefully explained.

In applying the science of accounting as an aid to the successful demonstration of a business or enterprise for gain, such as are all privately conducted water supply enterprises, two principal classes of accounts are always employed, herein explained, respectively, as "Balance Sheet Accounts" and "Revenue and Expense Accounts."

In addition to these two principal classes of accounts, the greater number of public and private enterprises keep additional or supplemental accounts to aid in furnishing the information needed for their systematic and scientific demonstration.

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Balance Sheet Accounts.

The balance sheet accounts of a water supply enterprise are those ledger accounts in which is kept a record of the wealth in the possession or control of the enterprise, and of the claims of its creditors and trust beneficiaries upon, and the equities of its properties or owners in, the wealth possessed or controlled. They are the accounts which, when properly summed up in a statement called a balance sheet, will present a correct exhibit of the financial condition of the enterprise at a specified time. These accounts are by some accountants called indicant accounts.

Revenue and Expense Accounts.

The revenue and expense accounts of water spppply enterpises are those ledger accounts in which are recorded the amounts that accrue as revenues or as expenses as a result of the operation of the enterprise. They are the accounts which, when properly summed up in a statement called a revenue and expense account, or income account, or operating statement, or by some other characteristic designation, disclose the result or outcome of the business for a given period of time.

TECHNICAL TERMS EMPLOYED IN BALANCE SHEET ACCOUNTS.

The financial data recorded in balance sheet accounts when classified according to character, are readily divided into three principal classes and a large number of subordinate classes. The three principal classes are those to which are herein given the designations "Assets," "Liabilities" and Propretary Interests." There are sub-classes of each. Following are given the definitions of three principal classes and also definitions of the principal specific designations applying to their sub-divisions and subclasses.

Assets.

The assets of a water supply enterprise are the properties or wealth in its possession or control or at its disposal, including rights of action, franchises, good will and other rights having a money value.

Actual and Nominal Assets.

The accounts of an enterprise in which are recorded its assets sometimes contain the record of (1) amounts due from the enterprise to one of its funds, or from one of its departments, divisions or accounts to another; (2) shares of stock issued by it and held in its general treasury or by one of its funds; (3) amounts which represent accrued costs and losses to be charged as expenses of future periods or which constitute other offsets to the credit balances of liability and proprietary interest accounts; and (4) wealth which is not now in its possession or control but which may come into such possession or control under certain circumstances or subject to specified conditions. Changes in the total of these amounts do not increase or decrease the wealth in the possession of the enterprise, and hence these amounts represent wealth in name only. They are accordingly here called nominal assets, to distinguish them from wealth actually controlled or possessed, here called actual assets. The amounts mentioned under (4) are generally called contingent assets.

There are many bases upon which the actual assets of an enterprise may be classified, and for this reason there are a large number of specific designations which may be applied to such assets. Classified with reference to form, the assets or an enterprise are spoken of as tangible and intangible; classified with reference to character they may be referred to as landed and nonlanded; and when classified with reference to the principal purpose of the business, they may be separated into two groups called, respectively, fixed assets and floating assets.

Tangible Assets.

The tangible assets of a water supply enterprise are the material or tangible wealth held or controlled by it, including land or landed assets, improvements on land, water supply system fixtures, equipment having an expectation of life of more than one year (exclusive of hand tools and other small tools that may be lost), cash, and materials and supplies on hand.

Intangible Assets.

The intangible assets of a water supply enterprise are the costs of its organization, the value of its franchise, its patent rights and all other intangible wealth in its possession.

Landed Assets.

Landed assets, referred to in the instructions for assets and expenses accounts as "lands," is the common designation of all freehold and other interests in land (exclusive of improvements thereon) the term of which is more than one year.

Nonlanded Assets.

Nonlanded assets comprises all assets not properly spoken of as landed in accordance with the foregoing definition.

Fixed Assets.

The fixed assets of an enterprise are those resources or forms of wealth which are employed by it in the accomplishment of the principal purposes of its business, and which have an expectation of life in service of more than one year (exceptions being made of hand tools and other small portable tools that may be lost or stolen, for which no particular person is made financially responsible). Expenditures which increase the aggregate value of the fixed assets of an enterprise are here called outlays, this term covering the accrued costs, paid or paybale, of lands, buildings, and other properties more or less permanent in character and thus available for more than a single use, which are acquired or constructed for the purpose of adding to or taking place of existing fixed assets.

The fixed assets of water supply enterprises are for accounting purposes arranged, according to their uses in the business, in three principal groups, which are here called general, departmental and miscellaneous. Definitions of these terms, as well as of a number of others applied to fixed assets, either in the classification of asset accounts or in the instructions with reference thereto are here given.

General Fixed Assets.

The general fixed assets or general properties of a water supply enterprise are those which pertain to the business as a whole and not to any particular subdivision thereof.

Departmental Fixed Assets.

The departmental fixed assets or departmental properties of a water supply enterprise are those which are directly employed in the various departments or branches of its work of collecting and supplying water to its customers.

Miscellaneous Fixed Assets.

The miscellaneous fixed assets or miscellaneous properties of a water supply enterprise are those which are used for purposes subordinate or incidental or accessory to the work of collecting and supplying water.

Landed Improvements.

Landed improvements, in the case of a water supply enterprise include buildings, miscellaneous landed improvements, building fixtures, and water supply system fixtures. Buildings include all houses, stations, sheds and other structures used for office, store house, shop or stable purposes, or for protecting equipment. Miscellaneous landed improvements include fences, roads, walks, drains and kindred improvements on land. Building fixtures is a designation for all material constructions such as water pipes, electric wires and their attachments, and all other structures permanently attached to and made parts of a building. Water supply system fixtures include all dams, reservoirs, pipes and other immovable structures located upon or in the ground for the purpose of collecting, purifying, pumping or distributing water.

Meaning of Words.

The word equipment, as here used, includes all furniture, machinery, tools, apparatus, and conveyances.

The word *furniture* is the common name for desks, chairs, tables, safes, filing cases, and the like.

The word *machinery* is the designation for pumps, elevators, hoists, engines, water wheels, and electric and other motors; boilers and furnaces, whether used for generating steam for engines or for heating purposes; dynamos for producing electric current, machine tools, cranes, shafting, belts, and other apparatus which are ordinarily employed in shops and which may be utilized in such places or elsewhere in connection with the water supply enterprise.

Tools is the common designation of hand and other small implements, including smithing equipment, employed for any mechanical purposes.

The word *apparatus* is the common designation of all mechanical devices and constructions used in scientific and professional work and experimentation, including those employed in chemical and bacteriological laboratories of the water supply system, and all the appliances used exclusively by the several engineers.

Conveyances is the inclusive name for carriages, wagons, carts, and horses or other animals to draw them automobiles, autocycles, bicycles, and other means of locomotion.

Original construction and *acquisition* is the designation most frequently applied to all fixed assets belonging to an enterprise which were constructed or acquired by it prior to the beginning of its operation.

Additions is the generic designation here applied to all new structures, fixtures, and equipment and other properties added to those in the possession or control of an enterprise at the beginning of its operation.

Replacements are mechanical changes in physical properties which have as their primary aim the substitution of one building, structure, piece of machinery, or equipment, for another, or the restoration of such building, etc., to a state or condition as good as that existing at the time when the displaced properties were acquired or constructed. Replacements always consist of new structures, or new sections of old structures, which can best ~~be treated in accounts~~ as new structures.

The word *renewals* is sometimes given a meaning identical with that assigned above to replacements. It is here used as the designation for changes in the value of properties which result from extensions of the term of duration of interests in land and other tangible fixed assets, and the extensions of franchises, water rights and other intangible fixed assets.

Betterments.

Betterments are mechanical changes in tangible properties which have as their primary aim and result the substitution of new structures or equipment that are better or of greater capacity or value than those displaced, or which result in making the properties affected more valuable and useful or of greater capacity than they were at the time of their installation or acquisition.

Floating Assets.

Floating assets is the common designation here employed in referring to that portion of the wealth in the possession or control of a water supply enterprise which is not included under fixed assets as defined above. The floating assets of a water supply enterprise are of two distinct classes, here designated, respectively, "current assets" and "invested assets."

Current Assets.

Current assets are those resources consisting of cash and other forms of wealth readily convertible into cash, which an enterprise possesses, that the available for meeting current expenses, interest and outlays, for making investments, and for meeting other claims of creditors and trust beneficiaries that mature or become due during the current fiscal period.

Invested Assets.

Invested assets, also called investments, include all forms of wealth that have been acquired and are held for purposes other than those for which the enterprise acquiring and holding them was organized and is maintained. Among the many purposes for which investments may be acquired and held are those of securing an income from them, of deriving gain by their rise in value, of avoiding losses that otherwise would be suffered, and of securing other business advantages that may seem possible through their acquisition and possession.

The account of many enterprises with their fixed, current and invested assets contain exaggerated statements of the value of those assets, owing to the fact that insufficient allowance has been made in the accounts for losses from depreciation and other causes. To the extent of these exaggerations the accounts include the record of nominal assets. Further it should be observed that when an enterprise holds among its investments, or otherwise, stocks, bonds or other securities issued by itself, these securities constitute nominal investments and may be recorded in accounts and summarized in balance sheets either as invested or as nominal assets, as may seem best from considerations of administrative expediency. But in whatever accounts they are recorded, the fact that such so-called investments are investments in name only or that the nominal assets include securities held for investment purposes should in some way be made evident.

Current and invested assets are called reserved assets when they have been withheld or separated from other assets of the enterprise, or are appropriated or otherwise set aside for specified purposes connected with the conduct or management of the business. The current and invested assets not devoted to special uses are here spoken of as unreserved assets.

The term current cash, notes and bills receivable, revenue debtors and non-resident debtors, prepayments and materials and supplies, it is believed, are sufficiently self explanatory, and hence no definitions are included here for the classes of assets included in these terms, but reference is made to the instructions for use of the accounts with these assets as to the scope of the terms as herein assigned.

Capital.

The word "capital," which at an early date became one of the most important technical terms employed by economists, is now used by them in the case of productive enterprises with a meaning substantially identical with that which most accountants assign to the accounting term "assets." It is the wealth employed by or in the possession of a given enterprise. Economists classify this wealth, or capital, according to its form, and refer to certain classes thereof as "fixed," "invested," "current," and "floating," substantially as accountants refer to the same wealth as assets. Spoken of as capital, the wealth in the possession and control of an enterprise is separable into two portions, referred to as credit capital, or creditor's capital, and proprietor's capital.

Credit Capital.

The credit capital or creditor's capital, of an enterprise is that portion of the aggregate wealth in its possession or control which represents the contributions to the enterprise either by creditors or for trust beneficiaries, and is measured by their claims. The term is never used in accounting as the designation of any class of assets, nor of any group of accounts, all claims of creditors and trust beneficiaries being recorded and summarized under the legal term "Liabilities."

Proprietor's Capital.

The proprietor's capital of an enterprise is that portion of the aggregate wealth in its possession or control which represents the property rights of its stockholders or other owners in its assets. The amount of such capital or wealth in a given enterprise is always measured by the excess of the value of its actual assets over the legal claims of its creditors and trust beneficiaries. The term "proprietor's capital" is never used in accounting as the designation of a class of assets, nor of any group of accounts, all property rights of stockholders or other owners in the assets being recorded and summarized under such terms as "capital stock," "stock," "surplus." "corporate capital," "proprietary interests," etc.

Capital Account.

Capital account is a designation at present applied by the great majority of accountants to a cash account in which are recorded, with certain minor receipts and payments, the receipts and payments on account of capital—that is, receipts which represents an increase in the amount of proprietor's capital and credit capital employed in the business, payments for fixed assets which increase the total capital employed permanently in the business, and payments for the liquidation of debts which decrease the amount of credit capital so employed. This usage is in harmony with the use of the word "capital" by economists, to which attention has been called. The word "capital" is also used by many accountants as the designation of all accounts summed up in the balance sheet. This practice involves the use of the word with a signification somewhat at variance with that attached to it by economists, and with other terms employed by accountants. For this reason the term "balance sheet accounts" has been preferred as the common designation of the accounts last mentioned.

Liabilities.

In the accounts of public service corporations the term "liabilities" is primarily employed as the common designation of (1) amounts of money or money's worth in the form of lands, goods, or service which an enterprise is under legal obligations to pay, deliver, or render to others or to their heirs and assigns; or (2) similar amounts which it is under legal obligations to hold, use or expend in specified ways or for specified objects in the interest of specified persons, and not in the interest of the enterprise. The term is also used to designate (3) amounts of money or other wealth which an enterpise owes to itself or to one of its funds, or which one branch or division of its business owes to another; (4) amounts recorded in so-called liability accounts by credit entries which represent accounting offsets to the debit entries of asset accounts, and which are amounts recorded (*a*) to assist in securing accounting control over specified contracts, such as those for maintaining sinking fund reserves, (*b*) to maintain accounting control over the legal regulation of governmental expenditures, such as are contained in appropriation acts or (*c*) for other purposes; and (5) amounts which the enterprise, under specified circumstances or subject to specified conditions, may be called upon to pay, deliver or render in the future, but for the payment, delivery, or rendering of which there is no present obligation.

Debts, Trusts and Nominal Liabilities.

Those liabilities of an enterprise which are included above under (1) constitute its debts, or its obligations to its creditors; while the liabilities included under (2) are properly spoken of as trusts, since they are its obligations to those for whom as trust beneficiaries the enterprise is acting as trustee. The liabilities properly spoken of as debts and trusts as above represent the claims of others upon the enterprise or upon its assets, and thus measure the amount of credit capital employed or utilized by the enterprise. Of the other amounts recorded in the so-called liability accounts of an enterprise, and referred to above under (3), (4), and (5), none represents wealth in any form which has been received from others or constitutes a claim upon the wealth in the possession or control of the enterprise. They are liabilities in name only and are, therefore, properly spoken of as nominal liabilities. In accounting these nominal liabilities should be carefully distinguished from the legal obligations mentioned under (1) and (2), or the accounts will fail to exhibit the true condition of business at any given time, and to set forth the results or outcome of transactions for any given period. The nominal liabilities mentioned above under (5) are generally called contingent liabilities. The debts, trusts, and nominal liabilities of an enterprise are separable, for administrative purposes, into two principle classes—fixed and current.

Fixed Liabilities. The fixed liabilities of a water supply enterprise are those which have a number of years to run, or upon which interest is to be paid in perpetuity, and for the amortization of which no assets, other than those of sinking funds, have been specifically authorized or appropriated. Such liabilities are usually evidenced by some formal instrument called a "bond," or are given some other descriptive designation. The fixed liabilities of a water supply enterprise are generally called "debts." An exception to this rule is met with in the case of such of its fixed liabilities as are held by the sinking and other funds, or otherwise as investments of the enterprise, which are not "debts" but "nominal liabilities." The fixed liabilities of a municipal enterprise, when spoken of as debts are generally given the specific designation funded, from the fact that provision has been made for their final amortization by "funds" generally called "sinking funds."

Current Liabilities. The current liabilities of a water supply enterprise are those which should be met and liquidated as a part of the transactions of the current fiscal period, or at an early date thereafter. These liabilities are of two classes: (1) Those for the satisfaction or payment of which provision is fully made by cash or other assets on hand, authorized or appropriated for that purpose; and (2) those for which no provision has been made. The curent liabilities referred to under (2) are generally referred to in legal decisions as floating debts. Excluding the nominal liabilities, which—with the exception of those mentioned above under "fixed liabilities"—may be considered as current liabilities, and excluding those current liabilities arising from deposits of customers to guarantee the payment of water rates or the rendering of specific services, etc., all current liabilities of water supply enterprises are "debts." The deposits of customers give rise to "trusts" rather than "bedts" and can best be recorded in accounts as "deposits by customers," although this designation should not be allowed to conceal the fact that the reception of these deposits gives rise to what in law are known as private trusts.

In addition to the classification mentioned above, liabilities are in the accompanying scheme of accounts classified upon a number of other bases, the resulting classes being given specific names corresponding to their popular or legal significance. Among such classification mention may here be made of those based upon (1) the time when liabilities becomes due or payable or are to be satisfied, and (2) the character of the instruction or record evidencing the debt or trust. Classified on the former basis liabilities are called outstanding due and demand liabilities, liabilities outstanding but not due, and outstanding liabilities awaiting final determination or adjustment; when classified on the latter basis, they are called bonds, notes payable, warrants payable, and accounts payable.

Funded, current and floating debts constitute outstanding due and demand liabilities, liabilities outstanding but not due, and outstanding liabilities awaiting final determination or adjustment, according as they are payable on demand at the present or at some future time, and according to whether the amount payable has been determined or adjusted or is waiting such determination or adjustment.

The term bond is more or less generally applied to every written evidence of corporate and municipal or governmental debt given under the seal of the city, state or nation issuing it. Less formal written evidences of indebtedness are given the specific designations notes payable, warrants payable, or audits payable, while the amounts recorded only in accounts are generally called accounts payable. Bonds and other fixed debt liabilities are of two classes; those guaranteed by liens or other security on specified property, and those not so secured. The secured by liens are called Mortgages, first second or third, according to the priority of the lien. Fixed debt obligations not secured by liens are here called debtentures.

Proprietary Interests.

In accounting, proprietary interests are the property rights or equity of the stockholders, owners or others who constitute the proprietors of the business or enterprise in the assets or wealth belonging to or employed in or by the business or enterprise.

Proprietary interests are by the great majority of modern accountants listed in balance sheets and ledgers as liabilities, and many writers on accounting have explained how these interests are liabilities of the business or corporation to the owners, but economists have pointed out the great difference between proprietary interests and liabilities. That difference may be summed up and stated very concisely by saying that proprietary interests are "rights in," while liabilities are "claims upon," the assets of a business or enterprise.

Proprietary Interests of Corporations.

The proprietary interests of corporations, which may be presented in balance sheet statements under the designation of corporate capital rather than under that of "proprietary interests," are vested in their stockholders, and are represented by certificates of ownership called "stock certificates." These certificates of stock are of four general classes, here called debenture stocks, first preferred stocks, second preferred stocks and common stocks.

Debenture Stocks.

Debenture stocks are those issued under an absolute contract to pay thereon at stated intervals a special return.

First Preferred Stocks.

First preferred stocks are those which have the first claim up to a special rate upon such dividends as may be distributed.

They may be cumulative or noncumulative, participating or nonparticipating. If cumulative the amount by which the dividend at any dividend period fails to reach the stipulated rate is carried forward to continue as a claim upon earnings until satisfied; if noncumulative, such amount lapses. If a first preferred is participating, it is not limited to the stipulated rate in the amount of dividends which it may receive, but is entitled to participate, in accordance with the terms of the contract under which it is issued, in further dividends; if nonparticipating, it is limited to the stipulated rate.

Second Preferred Stocks.

Second prefered stocks are those whose claims in the distribution of dividends are next after those of first preferred stocks. These stocks also may be cumulative or noncumulative, participating or nonparticipating.

Common Stocks.

Common stocks are those whose claims in the distribution of dividends are subordinate to the claims of all other stocks.

In addition to the differences in corporation stocks noted in the foregoing definitions, it should be observed that stocks differ in regard to the voting power incident to their ownership, and the stocks are sometimes issued under contracts wherein the issuing corporation reserves to its self the right, either absolute or subject to conditions expressed in the contract under which the stocks are issued, to retire them at its option.

Proprietary Interests of Municipalities and Individuals.

In their essentials the proprietary interests of municipalities and individuals in the water supply enterprise owned and operated by them are the same as those of stockholders in corporate enterprises, although such interests are differently evidenced. The interests of municipalities and of individuals may be considered as constituting an undivided whole, as contrasted with the collective ownership of the stockholders of a corporation.

Proprietary Interests, How Divided.

The proprietary interests of stockholders in the property of corporations, and those of individuals and municipalities in the enterprises controlled by them, when considered from a legal standpoint, consist of a single and indivisible whole. For accounting purposes, however, they are considered as separate or separable into the original contributions to the business made by stockholders and other proprietors and wealth obtained in some other way. Thus the proprietary interests of individual owners are for the purpose mentioned separable, if not separated, into those which represent the original or first contributions made to the business, and those added thereto in the shape of profits earned but not withdrawn from the business. The former are spoken of by a variety of designations descriptive of the facts involved, and the latter are called surplus. In like manner, the proprietary interests of stockholders in the properties of a corporation are separated into those which spring either from the whole of the stockholders' contribution or contributions to the business or that portion of the whole which was represented by their payment for the par value of the certificates of stock, and all other interests of the stockholders. The former class of interests are recorded in corporation accounts under the general designation stocks and the latter class, under the name surplus. The proprietary interest of municipalities and governments are not separable or separated in the manner stated above for private individuals and corporations. All the interests of the people as proprietors represent contributions and no part surplus or undivided profits. The surplus recorded in the accounts of individual and of corporations, and the proprietary interests of municipalities, considered as a whole, are divisible according to the uses made of them into two general groups known respectively, as reserves, surplus reserves or proprietary reserves, and unreserved surplus or unreserved proprietary interests.

Surplus Reserves, Proprietary Reserves, or Reserves.

Surplus reserves, proprietary reserves, or reserves are amounts or portions of the property rights or equity of the proprietors in any business that are reserved or set aside from the ordinary purposes of the business and dedicated or appropriated to specified purposes. In the case of private individuals and corporations, these reserves are always portions of the "surplus" and are thus properly called surplus reserves.

The most common purposes for which the surplus of corporations and individuals and the proprietary interests of municipalities are reserved are for meeting further losses from bad debts, unwise investments, depreciation, casualties, and kindred causes, and for the amortization of loans or for the acquisition of additional fixed assets, the making of replacements and renewals, the purchase of investments, and allied objects.

Proprietary reserves are given many different names. Those which must be kept intact during the life of the corporation are called permanent reserves. The permanent reserves most frequently met with in corporation accounting are those arising from premiums on stocks issued. Temporary reserves are surplus or proprietary reserves that are not intended to be kept intact during the life of the corporation or of the municipality. They are separable into two sub-classes known as contractual and noncontractual reserves.

Contractual Reserves.

Contractual reserves are reserves necessitated by contracts, such as reserves to cover sinking funds provided for by mortgages. Non-contractual reserves are such temporary surplus or proprietary reserves as are reserved without being required under any contract.

Proprietary or surplus reserves are to be carefully distinguished from unadjusted claims, arising from past losses, which are sometimes—though improperly, called reserves. Such claims are liabilities, and should be recorded, as has been stated, in accounts with "outstanding liabilities awaiting final determination or adjustment." With reference to such claims, the word "reserves" can signify nothing more than the word "estimates," which should be used rather than the word "reserves," since its use would obviate the confounding of a liability with a proprietary interest.

Nominal Proprietary Interest.

Attention has already been called to the fact that the asset accounts of a water supply enterprise may include amounts which do not represent wealth in the possession or control of the enterprise but are amounts that are assets in name only. So far as these nominal assets are not balanced by or constitute offsets to nominal liabilities, they are balanced by credit entries in proprietary interest accounts, and such credit entries not representing any property rights of the owners can properly be spoken of only as nominal proprietary interests. Among the nominal proprietary interests of privately managed water supply enterprises are those which are represented by shares of stock held in the treasury or by one of the funds of the enterprise. Other nominal proprietary interests that may be recorded in the accounts of publicly as well as privately owned enterprises are those which represent (1) discounts and other deductions that will be allowed in the collection of revenue bills charged on the ledger, and (2) losses by depreciation, bad debts, bad investments, etc., that have previously taken place and that have been met from revenues by charges in the expense or profit and loss allocation accounts, but which have not yet been recorded and thus cancelled or written off in accounts with those assets whose changes in value give rise to the costs and losses which constitute the expenses mentioned. The amounts last mentioned are sometimes called "reserves," but are nothing more or less than offsets to actual or nominal assets, and hence should be recorded in accounts under names that disclose at a glance their real character as nominal and not actual proprietary interests.

Classification of Proprietary Interests in Accounts.

In classifying proprietary interests for a uniform scheme of accounts such as are here provided, recognition must be given to all the differences which arise by reason of the varying forms of ownership. Further, the classification should be made in such a way as to permit a summary of data under a few comparable heads. The heads provided for the purpose are (1) stock and unreserved proprietary interests, (2) reserved proprietary interests, and (3) miscellaneous nominal proprietary interests. Under the first head should be included the interests of private corporations represented by their stock and undivided and unappropriated surplus, and all real and unreserved proprietary interests of municipalities and private owners. Under the second head should be included all reserved proprietary interests of corporations, municipalities and individuals, and under the third head should be entered all nominal proprietary interests recorded in the accounts other than those represented by capital stock held by sinking and other funds of the enterprise.

TERMINOLOGY OF REVENUE AND EXPENSE ACCOUNTS.

The data to be recorded in the Revenue and Expense Accounts of Water Supply Enterprises are readily separable into two general groups, to which are given the specific designations "Revenues" and "Expenses." Herein immediately follows definitions of the technical accounting terms which are used to designate the several classes of the two general groups.

Revenues.

The word "revenues" is at the present time employed by accountants in referring to amounts of money or money's worth which individuals, corporations or enterprises other than those engaged in buying and selling merchandise, receive or become entitled to receive as the result of business transactions, from property sold or services rendered, and as returns upon property or interests in property. The word is here used in connection with the accounts of water supply enterpries, with the meaning and signification assigned to it in the usage mentioned above. The revenues of water supply enterprises, which are derived from two distinct sources and are thus readily separable into two classes, are here called operating revenues and miscellaneous revenues.

Operating revenues are those derived from furnishing water to customers, including the value of water supplied without compensation. As the great majority of cities speak of such revenues as "water rates," or "rates," this designation is sometimes used in the instructions for the use of accounts interchangeably with that of "Operating Revenues."

Miscellaneous Revenues.

Miscellaneous revenues include all revenues of water supply enterprises other than those obtained from furnishing water to customers.

The revenue of an enterprise is the aggregate of its revenues from all sources. In the case of water supply enterprises it is the sum of its operating and miscellaneous revenues. In addition to being used as a noun with the foregoing signification the word revenue is employed as an adjective in many compopnd terms.

Revenue Accounts.

Revenue accounts is the generic designation of all accounts in which accruing and accrued revenues are recorded or by means of which they are summarized.

Expenses.

Expenses are (1) the accrued costs, paid or payable, of services, rents and materials utilized in the conduct or management of an enterprise; and (2) its losses due to depreciation and kindred causes. They are the costs and losses which must be met from, charged to, or deducted from, revenue, in order to ascertain the income secured by the management of the enterprise as compensation, in the form of interest and dividends, for the capital employed by it.

Expenses may be classified in many ways, and thus may be referred to under many specific designations. When classified with reference to the branch of the business for which they are incurred or suffered, the costs and losses of a water supply enterprise which constitute its expenses are here spoken of as operating expenses and miscellaneous expenses. Operating expenses are divided into general expenses and departmental expenses. The departmental expenses as well as the general expenses are subdivided into running expenses, expenses for reparis, expenses for insurance, expenses for taxes and expenses for depreciation and amortization. The foregoing subdivision of expense is devised principally for accounting purposes and permits them to be summarized by the branches of the business in connection with which they were incurred and also by craracter or object. These various classes of expenses may be described as follows:

Operating Expenses.

Operating expenses is the generic term which is employed in referring to the costs and losses of water supply enterprises arising and resulting from the furnishing of water to its customers, to which are given the specific designations "general expenses" and "departmental expenses."

General Expenses.

General expenses are (1) the costs and losses of an enterprise incident to the general administration and management of its business and the collection of its revenues, including expenses for repairs, insurance, taxes and depreciation of and on buildings and equipment employed in such administration, management and collection; (2) the costs and losses which pertain to the business as a whole rather than to any particular subdivision thereof such as franchise dues, and depreciation and amortization of general tangible and intangible assets and property. The expenses included under (1) are hereafter referred to as general management expenses.

Departmental Expenses.

Departmental expenses are the costs and losses of a water supply enterprise which are directly connected with specific branches of the business of collecting and furnishing water to customers, including the costs and losses incident to the repairs, insurance and depreciation of, and the taxes on, the properties, appliances, and fixtures employed in the business which are not specifically used in connection with the general management of the business. The branches of the business of the enterprise as referred to above are respectively the collection system, purification system, pumping system, and distribution system.

Collection System Expenses.

Collection system expenses are those expenses of a water supply enterprise incidental to the running, repair, insurance and depreciation of and taxes on the collection system of the enterprise. The collection system is here considered as including reservoirs, dams, and other structures and fixtures used for the collection of water and for conveying it to the purification or pumping works; the land upon which such reservoirs, dams, structures and fixtures are located; and the structures and improvements upon such lands which are not used for purfication or pumping purposes.

Purification System Expenses.

Purification system expenses are those expenses of a water supply enterprise connected with the running, repair, insurance and depreciation of, and taxes on, reservoirs and other fixtures, appliances and equipment employed primarily for the purification of water, including land on which such reservoirs, etc., are located, and the improvements, etc., thereon. The land, reservoirs, etc., mentioned constitute what is here referred to as the purification system of a water supply enterprise.

Pumping System Expenses.

Pumping system expenses are the expenses of a water supply enterprise connected with the running, repair, insurance and depreciation of and taxes on the machinery, fixtures and equipment of such enterprise which are employed directly or indirectly in pumping water. Such machinery, fixtures and equipment are here called the pumping system of a water supply enterprise. They include, among other things, the boilers for generating and supplying steam, the water power dams, canals, wheels, etc., for supplying hydraulic power, steam engines, steam pumps, other pumps, electric motors, gas and gasoline engines and gas producer apparatus, etc., and all other appliances used in the work mentioned, together with the buildings in which they are located and the land upon which they are situated, etc.

Distribution System Expenses.

Distribution system expenses are the expenses of a water supply enterprise connected with the running, repair, insurance and depreciation of, and taxes on, the reservoirs, standpipes, elevated tanks, pipes and other fixtures and appliances connected with the distribution of water to customers and with storage for such distribution, together with the land and rights of way upon or in which the same are located, and the buildings and other structures provided for use in connection therewith, all of which constitute the distribution system of a water supply enterprise.

Miscellaneous Expenses

Miscellaneous expenses are the expenses of a water supply enterprise which are incident to miscellaneous revenues; or in other words, incident to the operation of the properties, funds, and accessory undertakings yielding miscellaneous revenues.

Running Expenses.

Running expenses of any department or branch of an enterprise, as included above in definition of departmental expenses, are the costs of the service, rents and materials, other than those for repairs, which are utilized in the conduct or management of the branch or department of the enterprise.

Expenses for Repairs.

Expenses for repairs are the costs of those mechanical and physical changes in the fixed properties and equipment constituting parts of the fixed assets of an enterprise, which are called repairs. These are changes which primarily affect the results of current operation rather than the value of the properties or equipment. They are the changes made for the purpose of keeping the properties in as good working order as they were originally expected to be after the lapse of time which intervenes between the date of acquisition or construction and that of the repairs. The term "repairs" should not, therefore, be applied to any mechanical or physncal changes which result in new structures or equipment, or in such reconstruction of the old structure or equipment as makes them in all respects as valuable and as serviceable or of greater capacity than they were at the time of original construction or acquisition.

Expenses for Depreciation.

Expenses for depreciation are the current losses suffered by an enterprise as the result of a lessening in the value of its properties due (1) to decay, wearing out, destruction, or obsolenscence of tangible assets as the result of physical changes or uses; or (2) to the supersession of tangible properties, or the destruction of the value of intangible assets, as the result of new inventions or discoveries, or changes in popular demand for or upon the properties or equipment affected, or of legislation or other factors affecting the value of the same. A lessening or diminution in value due to the factors mentioned under (1) is here called a physical depreciation; and that brought about by the factor mentioned under (2), a functional depreciation. Physical depreciation, due to gradual decay, wearing out or obsolenscence of physical properties, is here called ordinary physical depreciation, while that produced as the result of some unforseen casualty is called extraordinary physical depreciation. The term depreciation when used without any qualifying word will, in the instructions relating to the use of accounts, be understood as meaning "ordinary physical depreciation," and the phrase depreciation by supersession must be understood as being used interchangeably with that of "functional depreciation." The latter is always to be classed as an extraordinary depreciation.

The losses suffered by depreciation, and thus the current expenses properly chargeable under that head, can seldom be ascertained and accurately stated at the time when they occur or are suffered, and hence can be expressed in accounts only by estimates. Some general rules for the preparation of these estimates are given in the instructions for fixed asset and expense accounts, under the appropriate head.

Some accountants, instead of using the word "depreciation" in accounts, as in the term "expenses for depreciation," use the term "amortization of fixed assets," or kindred terms involving the use of the word "amortization" in connection with the name of the asset affected by depreciation. In this scheme of accounts the word amortization is used in this sense only in connection with intangible assets such as franchise values, the value of patent rights, etc., the cost or appraised value of preliminary operations and terminable rights in land.

GENERAL DEFINITIONS.

Incomes and Operating Losses.

The income of an individual is the wealth that comes to him or accrues to his benefit (1) as earnings, or compensation for services rendered; (2) as rent from land (3) as gains from business, the investment of capital, etc., or (4) as the result of all the factors here mentioned. The income of a corporation or enterprise is the gain that accrues to the capital invested therein as the result of the business conducted by it. The income of a water supply enterprise is the excess of its revenues over its expenses. That portion of this income derived from its water service, or the excess of its water service or operating revenues, over water service or operating expenses, is here called the operating income; and that derived from miscellaneous sources is called miscellaneous income. The corresponding excesses of expenses over revenues are here called respectively, operating loss, and miscellaneous loss. The words income and loss when used without the limiting words preceding, are used as the designations, respectively, for the total of operating and miscellaneous income, or of operating and miscellaneous losses, or in other words the net difference between all revenues and all expenses.

Interest.

Interest is the generic designation of all amounts that accrue or become payable from a person, firm, corporation, or municipality for the use of credit capital. In the case of an enterprise such as a water supply system, it is that portion of its income which is paid and payable for the use of credit capital.

Profit and Corporate Loss.

Profit is a generic term employed by economists and accountants in speaking of the advantage or gain that accrues to the stockholders of a corporation, or to the owners or proprietors of a noncorporate enterprise, as the result or out-come of the business transacted by such corporation or enterprise. In the case of a water supply enterprise, it is the excess of "income" over "interest," or of revenue over expenses and interest. The corresponding excess of expenses and interest over revenue is called a corporate loss or enterprise loss to distinguish it from the loss, operating and miscellaneous loss.

Dividends and Assessments.

Dividends is the generic designation of all amounts of profit appropriated or apportioned to the stockholders of corporations, and assessments is the corresponding designation of all amounts of losses apportioned or allotted among such stockholders. The profits and losses apportioned to or among firm members receive no specific designations corresponding to the terms "dividends" and "assessments," and with the undivided ownership of enterprises owned and operated by an individual or a municipality, there can be no apportionment of profit or loss, and hence no use in the accounts of such enterprises for the terms mentioned above.

Summary of Business Results.

The summary statement of financial results that is periodically prepared for enterprises by closing into it the revenue and expense accounts is given many different designations by accountants and business men and is also prepared in many forms—sometimes as a single account or statement, and sometimes as several separate but related statements—each receiving a characteristic designation, depending upon the nature of the business for which it is prepared. The statement or account here provided, for summing up the financial results of a water supply enterprise is arranged in two general divisions, to which are given the names revenue and expense account or income account, and profit and loss account.

Revenue and Expense Account, or Income Account.

Revenue and expense account, or income account, is the designation here given to that portion of the summary of the financial results of a water supply enterprise in which is shown the income realized, or loss suffered, during a given fiscal period. The summary may be prepared as a single statement or account, or in three subdivisions showing separately the operating income or operating loss, the miscellaneous income, or miscellaneous loss, and the profit and loss allocation, thus including all factors of operation and management. The income or loss shown by the revenue and expense account should, if the statement or account is made up in the three subdivisions mentioned above, always be closed into the third division of the summary of financial results, the profit and loss account.

Profit and Loss Account.

Profit and loss account, is the designation here given to that portion of the summary of financial results of water supply enterprise in which is shown the profit realized or corporate loss suffered during a given fiscal period. It is the account into which are closed the revenue and expense or income, account and all accounts with interest. It is also the account debited with all dividends declared and other apportionment of profit made, and credited with all assessments levied on stockholders, and with all other allocation of losses. The balance of the profit and loss account is either a current surplus or a current deficit; the former being the excess of income and of all assessments levied over interest and the dividends declared and the latter being the excess of losses, interest, and dividends over income and assessments.

The balance of the profit and loss account of a corporate enterprise is always closed into the balance sheet account for corporate or unreserved surplus, or corporate deficit, the balance for which is always the algebraic sum of the current surplus or deficit and the corporate surplus or deficit of preceding years. The profit and loss account of an enterprise operated by a private individual or firm should be closed into the account with the individual owner or owners.

When a water supply enterprise is operated by a municipality it will have many transactions with the municipality itself, in some of which the enterprise receives services, materials and money from the city, while in others the city receives them from the enterprise. For all such enterprises a balance sheet account should be credited with the services, materials and money received from the city and debited with the services, materials and money furnished or paid to the city. The balance on this account should be debited or credited to the profit and loss account before that account is closed into the account with unreserved revenue accumulations, herein designated "unreserved surplus other than corporate capital and surplus."

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THE IMPORTANCE OF FORESTRY IN PENNSYLVANIA. PRACTICAL ECONOMICS

BY ROBERT S. CONKLIN.*

Pennsylvania, at one time, was "one of the best timbered states of the Atlantic Coast." Mr. Gannett, geographer of the U. S. Government, in the 12th census gives the total area of Pennsylvania as 28,594,560 acres, and the area originally wooded as 28,160,000 acres. The census for 1900 gives the wooded area as 14,720,000 acres or about 51% of the total area. In 1902 Dr. Fernow, ex-Chief of Division of Forestry at Washington, D. C., gave 54% of the total area as brush, forest, and waste land, with probably only 24% in forest, which corresponds very closely with, but still exceeds the estimate of Dr. J. T. Rothrock, former Commissioner of Forestry of Pennsylvania, made about the same time. Since then lumbering, clearing, and fires have continued, so that today probably not more than about 5,000,000 acres are capable of yielding saw timber of some size.

From another standpoint, we have the facts that in 1860 Pennsylvania stood in the lead of lumber producing states. In 1900 the State was fourth in value of products; in 1905, fifth, while in quantity it advanced from fifth place to fourth, "indicating" as the Census Bureau states, "that the better grades of timber in the State are being exhausted and lower grades cut in increasing quantity."

According to the census reports, the average cut per year for the last twenty-five years has been about 2,000,000,000 board feet. From the reports of the Pennsylvania Department of Forestry, the average cut per year for the last decade has been about one and one-half billion board feet. The Forest Service of the U. S. Government, which is now very closely in touch with the lumber interests of the country, gives the cut for 1908 as 1,203,041,000 board feet. Evidently, with lumber in demand as it is, if plenty of lumber were to be found in this State, the annual cut would increase in quantity and quality as well.

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*President Penna. State Forestry Reservation Commission.

Annual Deficiency.

The population of Pennsylvania in 1910 was given as 7,665,111. Fernow (Economics of Forestry, page 37, 1902) states that the per capita consumption of wood in the United States is 350 cubic feet, 85 cubic feet being log material, equivalent to about 500 board feet. In the second volume of the report of the National Conservation Commission, page 349, it is stated that the annual consumption of wood in the United States is 260 cubic feet, 160 of which is timber, equivalent to about 950 board feet. Taking the minimum estimate of board feet by Dr. Fernow and the data of the last census, there is used in Pennsylvania 3,832,000,000 board feet. More than three times what was cut in 1908! Using the minimum estimate of cubic feet per capita, our requirements are 1,993 million cubic feet. The annual production by Pennsylvania sawmills, large and small, of all kinds of material, is less than 500 million cubic feet, which again is less than one-third of what is used. And these figures must be near the truth for our citizens are paying tribute to every lumber producing region of the continent and to transportation companies for that which might be produced at home.

Pine Swamp Planting Operation. April, 1910. Centre County Reserve.
The fires have killed all trees and burned all soil covering. Thousands of acres in the State are like this and must be planted in order to be reforested.

Experience has shown that such forests as we have now, if protected, will produce annually 200 board feet per acre. Actually they are not producing more than 100 board feet per acre per year. If we take the forest area as given by the U. S. Forest Service in 1908 (Report of National Conservation Commission, Vol. II, page 346) as 9,200,000 acres, one year's accretion would not supply one-fourth of the market demand; but since there are actually only about 5,000,000 acres, or less, that are potential forests, the annual production does not exceed one-half of one billion board feet. Surely we are rapidly cutting into our wood capital.

The average annual production of German private forests is about 30 cubic feet. To supply the demand of Pennsylvania saw mills and insure a continuance of operation, allowing a cut of 450,000,000 cubic feet, there would have to be maintained as private forests with little or no care, 15,000,000 acres. But the average annual growth of well managed forests in Germany is from 50 to 70 cubic feet; so if 9,000,000 acres were maintained as forest and well managed, the present industries could be sustained; but it must be remembered that our mills produce only about one-quarter of what is used. The simple conclusion is that we can never again supply our own needs unless we very materially reduce the per capita consumption and despite substitutes for wood, consumption will rather increase than decrease for some time to come.

Again, suppose that there were standing on each acre of forest land today 1,000 cubic feet of wood, that it were all used to supply the needs of the sawmills and that it were taken clean as the workmen advanced, it would mean the laying bare of between 450 and 500 thousand acres each year, which without allowing for annual production means the entire removal of our forests in twenty years at present rate of cut. Allowing an annual production of 15 cubic feet per acre per annum on 9,200,000 acres, the time would be extended to 30 years. The horrible truth is that we do not have 9.200,000 acres of potential forest; and if every acre of land adapted to forest growth were planted to-day, saw timber could not be grown in thirty years.

Area Adapted to Forestry.

There is much of the surface of the State of Pennsylvania which is adapted to nothing else than to the growing of forests. The soil is too steep or too poor for any form of agriculture, and no valuable minerals are beneath the surface. Even in what were once valuable mining or oil regions, the mineral resources are now exhausted and such lands are now valuable only for what the surface soil will produce in the form of trees. Whole townships and even counties which were once furnishing employment to many men, and taxes to local and State governments, are now practically uninhabited, and too poor to maintain themselves properly. Industries have closed out, and more are about to cease; many of the people have moved to the towns or into other townships or counties, and what few are left, eke out a miserable existence in some way.

There must be close to 15,000,000 acres of Pennsylvania better adapted to tree growth than to the production of any other natural resource, and of it at least 8,000,000 acres are either barren and entirely unproductive under present conditions, or, if there is any production at all, it is more than offset by the annual loss or expense. If immediate and complete steps were taken to improve this vast area, all but a very small percentage could be reclaimed; but with no protection from erosion and almost no protection from fires which destroy the humus on forest land, the absolutely barren area is ever and rapidly on the increase.

It is to be regretted that the people and government of Pennsylvania permit almost one-quarter of her area to remain in an economic unproductive state, and this too at a time when everyone is considering the high cost of living.

Young Hardwood Forest Killed by Fires
Thousands of acres in the State are similar to this.

Losses Incident to Forest Destruction.

It is no longer necessary to call attention to the serious condition of affairs in certain foreign countries, or even in sister states, with reference to the loss resulting to agriculture, manufacturing, navigation, and public utilities from deforestation of important watersheds. Every year the varied interests in our own State suffer damages amounting to millions of dollars from floods and droughts. Only recently, in one flood, the loss of property about Pittsburgh was estimated at between fifteen and twenty millions of dollars. Many lives were lost; 100,000 working people were thrown out of employment, and many businesses were materially crippled for some time. The Pittsburgh and

Allegheny Chambers of Commerce, the residents of western Pennsylvania, have asked that something be done to protect them, suggesting that 2 billion seedlings be planted at the headwaters of the Monongahela and Allegheny rivers. A preliminary reconnaissance of the whole region has been made. A Pittsburgh Flood Commission has been created and millions of dollars may be spent by people, corporations, State and National governments before an abatement in loss is brought about. Millions of dollars are now voted to investigate the "cause of floods," for deepening waterways, cleaning harbors, etc., and yet, while everyone knows that to a great extent the remedy for such conditions is reforestation and forest protection, the forestry cause has to go begging.

It is not stretching the truth to say that the loss to agriculture in our State as a result of forest destruction will run into the millions of dollars. Crops and orchards are left without protection from drying winds which cause the rapid drying out of vegetation and soil; the home of birds which protect crops from insect enemies is removed, and consequently the birds themselves; acre after acre in the State is rendered unfit for agriculture by reason of its being washed away by torrents that wooded hills should have held back, or by being covered with debris from higher ground washed over fertile farms; and besides, wood, which of itself is very important to the farmer in many ways, is now hard to get and at best is expensive.

Railroads, mine operators, telephone and telegraph companies, pulp mill men, tanneries, charcoal furnaces, building contractors, and men in almost every industry using wood in any form, are not only discussing wood scarcity, but are actually scared in regard to it. Indeed, many of the corporations are purchasing land or managing what they now own with the idea of growing timber for their future uses. It has become absolutely necessary that they should do so, and more than this, wood preservation by impregnation processes is constantly on the increase; so that the present supply of wood may be made to last until a new supply can be grown. Men of various interests are now agreed that the timber supply of the United States will last about twenty-five years.

The Game Commission is seeking the cause of the decrease in game fish, game birds, and other animals. It needs but to look at forested regions and deforested regions to see the difference in conditions, and then draw conclusions. Fires and lack of shelter settle the question.

Purity of water supply and evenness of flow is a necessity to the life of the people. There is no better purifier or regulator of water supply than a well managed forest.

Reforestation a Public Duty.

To any open mined man, this is enough to convince him that if he still discredits the importance of forests in the life and welfare of a State, he ought to follow the suggestions given and see

Hemlock Forest Along Swift Run, Snyder County Reserve

Young White Oak, Henry Valley, Pennypacker Reserve, Perry County

This condition would be common had forest fires been entirely suppressed where he is led even by taking a most liberal view in regard to every point.

Now, further, once it is recognized that forests ought by all means to be cared for, the question comes at once as to who shall care for them. They belong to private individuals and to corporations and someone always says, "Let them look after their property to suit themselves." That has been our policy of the past and the results are upon us to-day. Corporations with their large holdings and interests at stake are beginning to see their mistake; but conditions are such that it is unreasonable to expect much from the private small holder; and yet he, too, will have to do something or have it done for him in the interest of the community.

Forests must be allowed only on soil which is unfit for the production of food crops; consequently, the financial returns are not usually as high as in the case of agriculture, and not nearly as high as in the case of investments in stocks and bonds. This fact makes it undesirable for an individual to make forestry a business in which he spends all his time or even employs a manager to spend all of his time.

From the principles of forest culture and management, as well as from the small returns per acre, it becomes necessary to have large bodies under one management to obtain the most satisfactory results. This necessitates an outlay of a great deal of capital; consequently, an individual is not apt to take it up.

Again, trees which are needed for construction and the better grades of timber require a life time to mature, and for an individual to begin planting now with the expectation of getting his return just before he dies, is not much of an inducement.

None of the above peculiarities are, however, an objection to a corporation or to a government, bodies which are formed for continuance after one generation. They can be satisfied with a low rate of interest on a perfectly safe production investment, as a well managed forest has proved itself to be, and to wait for the deferred annuity for an indefinite time. In addition, by reason of the economic value which a forest has, it is particularly a function of the State to care for forests. In our American ideas we do not like the government to impose restrictions upon individual rights, so the only thing to do in this case is for the State to own its forests and to manage them to the best interests of the Commonwealth at large. This the State of Pennsylvania has begun to do and now owns about 945,000 acres. It should continue this policy until it owns not less than 6,000,000 acres in order to approach what may be considered a consistent policy of State control.

Pennsylvania State Program.

In the purchase of all the land which is now under the control of the Department of Forestry, the Reservation Commission has been ever mindful of the interests of the State as a whole. Careful investigations are first made as to the value of the land

and then as to the title. No more is paid than the land is actually worth and no land is accepted unless the title to the Commonwealth is good and without reservations of any kind. Up to date the average price per acre is about $2.25, which is hardly more than the value of bare soil; and yet time after time offers by prospective purchasers of young, thrifty timber standing on many of the tracts amount to three and four times what was paid for the land and growth. Such timber is increasing in value and the Department of Forestry does not propose to do anything but protect it and harvest it only when it is mature; but above all things, it must be protected. There are thousands of acres which should be carefully improved by removing dead and worthless trees, so as to make room for young and thrifty trees which will rapidly become useful. Again thousands of acres will have to be planted with valuable trees if anything at all is to be gotten from the land even in the far future.

White Pine Forest Plantation, 1907

Fire Protection the Pressing Demand.

The Protection of the State Reserves from fire is the most important proposition in their management at present. The same thing may be said of all the forests within the State. Prevention of fires is absolutely necessary, and yet it is most difficult to get our people to realize that prevention is far cheaper than remedying the evil after it has started on its way of destruction. For adequate protection an efficient force of foresters, rangers, and laborers is necessary; a system of roads and trails must be planned and built; fire observatories must be built; telephone systems must be installed. For the proper management, aside from protection, there must be buildings of various kinds, nurseries, tools, and machinery, horses and wagons, etc. All this requires large sums of money, but it must not be forgotten that every dollar put into the State Reserves is put there as an investment from which the State will receive both direct and indirect returns.

Were it not for the fact that in a number of foreign countries the same conditions, as we now have, existed and have been wisely met; and were it not for the experience of such nations, one might reasonably accept the criticism that what has been stated is an unfounded scare and that perhaps nature will take care of the trees as she has in the past without our expending a lot of money. Had we as much time at our command, and such lavish resources as nature, we might be content to wait 300 years or longer to bring about conditions which nature, with man's help, can accomplish with even better results in half the time or less.

Assistance for Forest Owners.

The State now owns less than one million acres of forest land and there are at least fifteen million acres which ought to be forest producing land. Surely the State has a duty in this matter outside its own property. It does not hope, nor would it be wise for it, to take in charge all of these fifteen milllion acres. Most of that vast area will always belong to farmers. Much of it will belong to corporations. The latter are more likely to practice forestry on their own account, but the farmers will have to be given some assistance.

From the standpoint of the individual the only inducement to practice forestry is that of financial returns in the near future. The principal impediments to conservative lumbering and to continued management of farm woodlots are high taxes and no protection from forest fires. These are things which the State can and should control. Taxes must be made to suit the proposition in hand, and still further means must be taken to prevent fires—not simply to put them out—"An ounce of prevention is worth a pound of cure."

If the bill which was before the Legislature becomes a law, it will make possible a great advance in forestry in the State. Woodlots or forests which are placed under the direction of the Department of Forestry will be assessed at a value of one dollar per acre for a number of years, and in return for the reduction in assessment must be cared for in accordance with the ideas of forestry as formulated for each tract by the Department. In this way the farmers and forest owners will receive technical assistance free; where a number of small tracts can be brought together, more systematic work may be done, protection can be better accomplished, and not only the individual owners but the community at large will be greatly benefited.

Where it is important that towns and cities purchase large forested watersheds as a protection to the purity and continuance of their water supply, or for park purposes, such forests may also be managed under the direction of the Department of Forestry.

UNIFORM SCHEME OF ACCOUNTS AND REPORTS FOR WATER SUPPLY ENTERPRISES.

(Second Installment.)

By Emil L. Nuebling,* Member.

(Being a Digest of the Report of the Committee of the American Water Works Association on the subject.)

SYSTEM OF UNIFORM ACCOUNTS AND ITS USE.

Prerequisites for successful system of uniform accounts.

The annual revenues of different water supply enterprises vary from less than one thousand to over ten million dollars per annum, and their assets vary from less than ten thousand to over one hundred and fifty million dollars. The number of accounts that are required, or that can be used to advantage, for administrative purposes by any enterprise must vary with the volume of business and assets, and hence a uniform system of accounts must first of all be adjustable to the requirements of large and small enterprises, and to this end must have the following characteristics:

(1) The financial data must be so classified and the accounts must be so arranged that the accounts will provide summaries of results or conditions along the same fixed lines and upon the same bases, so that comparisons can be made between the summaries of different fiscal periods and between those of similar enterprises.

(2) The accounts must so divide and subdivide expenses as to disclose the three elements which make up the total cost of service—the demand cost, the customer costs, and the consumption cost; and in turn must separate these costs into those that are fixed and those that are variable, so that from data it will be possible to determine the equity and wisdom of the existing rates for service, and also to make all proper revision of incorrect rates for such service.

(3) The accounts must be so designated as to make the system readily understood and thus easy of application.

Groups and orders of accounts.

To meet the requirements stated, the accounts of this scheme of uniform accounts have been arranged in different groups, subgroups, classes subclasses and minor subdivisions, and are therefore of several orders, each order and each account bearing a definite relation to all others. The scheme has been so devised that the number and kind of accounts employed may be adapted to the requirements of each enterprise, while at the same time accounting data of a uniform and comparable character has been provided.

In the introduction, attention has been called to four principal groups of data to be recorded in the balance sheet accounts and five other groups to be recorded in the revenue and expense accounts. One order of accounts is provided for these nine principal groups of data, a second for the several subgroups of the same data, a third for the classes of data into which the several subgroups are divided, and fourth and fifth orders, where provided, are for the subclasses and minor subdivisions of data to be entered of record in the accounts. In order to obtain comparable results, as mentioned above, the financial data to be recorded in these orders of accounts must be classified along fixed lines, and a given account must always be used to record data of the same character. Further, the accounts have been given names and other designations that will locate each individual account as readily as the ordinary index indicates the proper page of a book.

The nine principal accounts designed for recording the financial data of the smaller enterprises and for summarizing such data for the larger enterprises, are assigned numbers as follows:

1. Fixed Assets,
2. Floating and Nominal Assets,
3. Liabilities,
4. Proprietary Interests,
5. Operating Revenues,
6. Operating Expenses,
7. Miscellaneous Revenues,
8. Miscellaneous Expenses,
9. Profit and Loss Allocation.

When the business of an enterprise is of such volume or character that its proper administration requires more than the nine accounts above mentioned, and use is made of accounts subordinate to them, as has already been explained, the accounts to be summed up in each of the nine accounts may be nine or fewer in number, as may be advantageous for administrative purposes. The accounts of this second order are indicated numerically by numbers containing two digits, the first or left hand digit indicating the primary group to which the account belongs, or the number of the account into which it is summarized, and the second digit marking its position among the subaccounts of the principal account. Thus the number 16, as applied to an account, indicates that it constitutes the sixth subgroup (distribution system properties) of the first group (fixed assets). The accounts of the third order bear the same relation to those of the second that those of the second bear to the first, and the same rule applies to the relation of accounts of the fourth order to those of the third, and of those of the fifth order to those of the fourth. The division and subdivision of data, and thus the use of different orders of accounts, may be extended as far as may be desired for any enterprise, however large; or it may be stopped at any point, only those accounts being employed that can be used to advantage. This feature of the scheme, which permits the use of a small number of accounts for a small enterprise is as important as that which provides a large number of accounts for the use of an enterprise with a vast volume of business. The numerical index for each account indicates its order and its place in the system, and provides all other information required for locating the position of the account and the character of the data recorded therein. Thus 16358 is the index number of the eighth subdivision of the fifth subclass of the third class (distribution main pipes and specials) of the sixth group (distribution system properties) of the first group of accounts (fixed assets). The number giving group, subgroup, class, subclass, etc., may be called the designation or account number, and is applied to every account employed by the enterprise.

Definitions. For convenience in referring to the groups, subgroups, classes, subclasses, and minor divisions of accounts, use is made of the following terminology:

Summary Accounts. Are the controlling accounts of all the general accounts and are assigned the numbers 1 to 9. Each summary account is the controlling account of all general accounts having as their first digit one that is identical with the number of the specified account summary.

General Accounts. Are those for subgroups of data and are indicated by numbers with two digits, the first of which indicates the group to which they are assigned and the second their position in that group.

Subgeneral Accounts. Are those indicated by three digits, and are controlling accounts for those with four digits.

Primary Accounts. Are those indicated by four digits, and are controlling accounts of those with five digits.

Subprimary Accounts. Are those with five digits, and are the controlling accounts of those having six digits, if such accounts are employed.

Clearing Accounts. Are accounts through which are adjusted the debits and credits that at the time of their original entry are incapable of proper distribution to their accounts of final entry. As their name indicates, the object of such accounts is to carry the items entered therein until it becomes possible to segregate them by months or other desired periods of time, or by the purpose for which they were used or consumed, or until they can be transferred to the proper branch of service or to the proper account of final entry.

In this scheme of account the usual practice of providing separate clearing accounts has been departed from, and for greater simplicity the appropriate balance sheet accounts affected by the data of clearing items should be used for their record. The accounts most generally used and required for the purposes of clearing are the following:

26. Prepaid accounts.
27. Materials and supplies,
29. Nominal assets.
32. Revenues of future periods levied in advance.

35. Accounts payable (see account 353).
36. Interest payable and accrued,
38. Nominal liabilities,
42. Reserved proprietary interests,
45. Offsets for revenue discounts,
46. Offsets for losses not recorded in asset accounts.

In addition to the foregoing, the incidental operating revenue and expense accounts under miscellaneous revenue and expense accounts, as is explained in the instructions for these accounts, are also clearing accounts for the data includible therein.

Special designations of accounts.

To avoid confusion in the designation of the character here described, it is important that the significance of the different account numbers shall not be changed without some clear indication of the fact. Such changes may be desired, for instance, in the case of several plants operated by one central organization where accounts are kept separately as to some feature of the plants and collectively as to others, through the same books. This, or any similar requirement, can readily be met by using a character other than the ten digits, or by adding the letters of the alphabet to the account number, as, for instance, *221a*, *221b*, *221c*, etc. Each account will thus assume its place in the fixed order and retain its full meaning, and no confusion will arise as to the significance of the classification. This plan of introducing letters or other symbols whenever it is desired, will give all needed freedom to the personal equation and afford scope for any desire for originality, and will meet all real wants for other or additional classifications in peculiar cases.

Use of the accounts.

As stated before, any enterprise can adopt as few or as many of the general, subgeneral, primary and subprimary accounts as it finds advantageous for administrative purposes, and its choice will not disturb the general results shown in the various divisions or centers of classification, since each division or center will show the revenue from certain sources and the expenses and outlays for the same objects or purposes, as the case may be. In order to secure the most comparable results and those possessing the greatest value for statistical purposes, however, enterprises of the same size should use accounts of the same order as their accounts of original entry. In this connection the following schedule is provided, and should in each case be adhered to by all water supply enterprises adopting this scheme of accounts, except that as many additional accounts of the next and following orders of account should be adopted and used in addition thereto as may be required to give proper accounting control of the details of the operations and financial data of the enterprise.

Class A. Enterprises having a gross annual revenue of less than $2500 should use summary accounts.

Class B. Enterprises having a gross annual revenue of $2500 and less than $25,000 should use general accounts.

Class C. Enterprises having a gross annual revenue of $25,000 and less than $250,000 should use subgeneral accounts.

Class D. Enterprises having a gross annual revenue of $250,000, and less than $2,500,000, should use primary accounts.

Class E. Enterprises having a gross annual revenue of over $2,500,000 should use subprimary accounts, subdividing the primary accounts in such detail as may provide the required accounting control of the enterprise.

In all classes of enterprises listed above, the accounts should be summarized into the proceeding and next higher groups of accounts, and thence into the next higher groups, etc., until the final data and results are summarized by all enterprises in the summary accounts. For the larger enterprises this is best done by carrying the lower orders or groups of accounts in detail in what may be termed an operating ledger, with the summaries of the accounts in such a ledger carried simultaneously under the titles of the higher groups, in the general ledger.

General rules and instructions.

In employing the system of account here described, the following general rules and instructions should be carefully observed:

All items of expenditure should be carefully classified by the heads of departments responsible therefor.

The classification of account numbers should be noted on orders and requisitions as issued and corresponding notes made upon bills and invoices as received, and upon the vouchers therefor.

When bills or invoices and vouchers contain amounts chargeable to several accounts, the account to which each item is to be charged or credited should be noted opposite the amount on the bill, invoice and voucher.

Supplies, material, and tools, as issued from the storerooms should be charged direct to the account benefited. Repairs of tools should follow the same course.

Salaries of clerks, foremen and street foremen, should be charged direct to the proper account in proportion to the time employed.

In classifying items, care should be taken to distinguish between expenses and outlays. This is especially necessary in the case of construction work performed by the force employed in operation. When questions arise in this connection, it should be remembered that an outlay account should include all items of draughting and other preliminary work and supervision, whether the work is done by employees of the enterprise or by contract. But discretion must be exercised so as to preclude the charging of a single dollar of expense to an outlay account; and to be on the safe side, the tendency should be, when in doubt, to charge to expense.

"Labor" should be understood to mean not only the manual work of laborers and mechanics, but also superintendence, supervision, inspection, clerical work, engineering other than the preliminary engineering of a general character which may in some cases be properly chargeable to outlay, and other items of a similar character, so far as they are chargeable directly to the account referred to or affected.

"Materials" should be understood to mean not only finished and unfinished products, appliances or parts. but such smaller articles as are usually termed "supplies" including in every case freight and drayage charges thereon, if any.

"Tools" should be understood to mean hand tools of mechanics and other tools used in the work chargeable to the account referred to or affected.

"Miscellaneous expenses" should be understood to mean all expenses chargeable to the account referred to or affected that are not for labor, materials, tools or items otherwise specially described, specified and mentioned.

The cost of experiments should be charged under expenses to the account most affected or benefited, unless scuch experiments are made in connection with and preliminary to some construction work, in which case this cost should be charged to the proper outlay account.

In closing the books, the balance of each account should be carried into the next higher account, that is, subprimary account balances should be carried to the respective primary accounts, the primary accounts balances should then be carried to the subgeneral accounts, the subgeneral account balances should then be carried to the general accounts, and the balances of the general accounts then in turn should be carried to the summary accounts, except where the instructions for the use of accounts hereunder may direct to the contrary. In the case of accounts recording assets, liabilities and proprietary interests, however, the balances of these accounts, of whichever order, may be forwarded into the next fiscal period in such detail as may be desired, the summarizing of the lower orders of accounts into the next higher orders of accounts being done, in such cases, in the balance sheet only.

I. FIXED ASSETS.

Classification of accounts and instructions for fixed assets.

10. Outlays for Uncompleted Properties.
11. Intangible General Assets and Properties.
    110. Outlays for Uncompleted Intangible General Properties.
    111. Corporate Franchises or Corporate Charter.
    112. Operating Franchises or Highways Easements.
    113. Preliminary Operations.
    114. Patent Rights and Licenses.
    115. Unamortized Discounts on Outstanding Stock.
    116. Miscellaneous Intangible General Properties.
12. Tangible General Properties.
    120. Outlays for Uncompleted Tangible General Properties.
    121. Administrative Office Properties.
    122. Accounting and Commercial Office Properties.

- 123. Business Promotion Properties.
- 124. Operating Management Office Properties.
- 125. Laboratory Properties.
- 126. Engineering Office Properties.
- 127. Store Room and Yard Properties.
- 128. General Operating Tools and Appliances.
- 129. Miscellaneous General Properties.

13. Water Supply Collecting System Properties.
    - 130. Outlays for Uncompleted Water Supply Collecting System Properties.
    - 131. Water Diversion Rights.
    - 132. Reservations.
    - 133. Impounding Dams and Reservoirs.
    - 134. Lake and River Cribs.
    - 135. Springs and Wells.
    - 136. Infiltration Galleries and Tunnels.
    - 137. Collecting Conduits and Reservoirs.
    - 138. Gravity Intakes and Suction Mains.
    - 139. Aqueducts and Supply Mains.
14. Purification System Properties.
    - 140. Outlays for Uncompleted Purification System Properties.
    - 141. Settling Basins.
    - 142. Coagulating Basins.
    - 143. Softening and Iron Removal Plant.
    - 144. Roughing Filters.
    - 145. Slow Sand Filters.
    - 146. Mechanical Filters.
    - 147. Ozone Sterilizing and Aeration Plant.
    - 148. Chemical Treatment Plant.
    - 149. Clear Water Basins.
15. Pumping System Properties.
    - 150. Outlays for Uncompleted Pumping System Properties.
    - 151. Pumping Stations.
    - 152. Steam Power Pumping Plant.
    - 153. Hydraulic Power Pumping Plant.
    - 154. Electric Power Pumping Plant.
    - 155. Gas Power Pumping Plant.
    - 156. Miscellaneous Pumping Plant Equipment.
16. Distribution System Properties.
    - 160. Outlays for Uncompleted Distribution System Properties.
    - 161. Transmission Mains.
    - 162. Distribution Storage Reservoirs, Tanks and Standpipes.
    - 163. Distribution Main Pipes and Specials.
    - 164. Main Pipes Valves and Valve Boxes.
    - 165. Fire Hydrants, Fire Cisterns and Connections.
    - 166. Main Pipe Fixtures and Appliances.
    - 167. Service Pipes and Stops owned by Enterprise.

- 168. Meters, Meter Boxes and Meter Vaults furnished rent free.
- 169. Fountains, Troughs and Other Equipment.

17. Incidental Operating Properties.
    - 170. Outlays for Uncompleted Incidental Operating Properties.
    - 171. General Shop Properties.
    - 172. Stables and Teams Properties.
18. Accessory Enterprise Properties.
    - 180. Outlays for Uncompleted Accessory Enterprise Properties.
    - 181. Compensated Plumbing Work Properties.
    - 182. Rental Real Properties.
    - 183. Rental Meters, Meter Boxes and Meter Vaults.
    - 184. Forest Lands Service Equipment.
    - 185. Miscellaneous Accessory Enterprise Properties.

Instructions for use of accounts.

In conjunction with the use of the accounts with fixed assets, there should be kept a property book or record, in which the fixed assets of the enterprise should be so classified and arranged that the record therein contained will be subdivided to correspond with the scheme of accounts under this subdivision and will contain a description of every piece of land belonging to the enterprise, a statement of the purpose for which acquired, used or held, and a detailed exhibit of all improvements on such land. The same record should show in detail all the fixtures, appliances, equipment and other fixed assets used by the enterprise, so arranged as to exhibit for each specific piece of property the year of its construction or acquisition. The data last mentioned is necessary to provide the basis for recording the additional information which should be contained in the accounts with fixed assets, viz: that exhibiting the effect of depreciation upon the value of the assets mentioned by recording the cost of each and every piece of property, the amount of ordinary and extraordinary depreciation upon such property suffered during the current year, and the total amount of such depreciation suffered from its acquisition or construction to the close of each fiscal year.

Any convenient method of recording this information may be adopted, but the method of presenting the data thus recorded, in order to obtain uniformity, should be as follows:

COST OF CONSTRUCTION AND PRESENT VALUE.
YEAR ENDING .... 19......

Original Cost, less Loss Discarded Portions and Decline in Price of Material, Estimated Life, Age, Depreciation and Present Value.

Acct. No.	Item No.	Description of Property.	Date of construction or acquisition.	Estimated life, years.	Age, years.	Original cost.	Cost of discarded portions and decline in prices.	Total depreciation and amortization for period of use.	Present value.	Value at end of previous year.	Depreciation and amortization loss during current year.
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Depreciation.

The losses of a corporation or municipality orperating a water supply system or other public service utility enterprise are progressively increasing with the passage of years for each structure, fixture or appliance constituting a part of its non-landed and of some classes of its landed permanent properties. Expressed in mathematical terms, it is now a more or less accepted axiom of business management that the losses from depreciation for any given piece of property, or of the water supply system as a whole, through a number of years constitute a geometrical series of which the loss of each year is a small per cent. greater than in the preceding year, and the aggregate loss at the expiration of the life of such piece of property, or system, is equal to its initial cost. The line which would represent this progressive increase of loss is sometimes called a "sinking fund curve." since it is used to represent graphically the progressive increase in the assets of a sinking fund whose resources are all kept invested at interest and into which is usually paid a fixed sum, and all its interest earnings are also added to the principal of the fund.

Depreciation is neither actually not relatively the same for any two establishments, even for the same industries. For this reason it is impossible to frame concise general rules for making allowances for depreciation, which will not in their application be attended with a large margin of possible error. To use such rules without causing errors, those employing them must have for each individual establishment exact data based upon inspection, showing how far and in what respects its actual depreciation differs from that of the average establishment of its class. For this reason a physical examination and appraisal of water works should be made every ten years, or even more frequently, in order to provide the basis for an approximate estimate or statement of the annual loss chargeable, as an expense to depreciation. In the absence of such exact data for each water supply system, however, it is to be assumed that depreciation takes place according to the average life of the several parts of such system and of water supply plants as a whole.

Until further study and experience, or a series of inspections and appraisals at fixed intervals furnish more accurate data, the average life of the various parts of the fixed properties of a water supply enterprise may be assumed to be approximately as follows: For horses, carriages, automobiles and laboratory apparatus and appliances ten years; water meters, service pipes, office furniture and general operating equipment, fifteen years; boilers, steam pipes and filtration equipment, twenty years; engines, pumping machinery and wood pipes, twenty-five years, masonry of filtration plant, cribs, iron water pipes, intakes and connections, fire hydrants, standpipes and buildings, fifty years; reservoirs, tunnels and aqueducts, one hundred years; and for the water system as a whole, fifty years. All these approximations are subject to modification by reason of any unusual conditions which may shorten or prolong the life estimated above.

American tables of depreciation have been calculated on the bases, respectively, of 4, 3, 2½ and 2 per cent of annual increment, but only a physical examination of the properties of any given enterprise, from time to time, can determine which one of these tables best reflects the actual depreciation which has taken place in any particular water supply system. The amount of that depreciation has no relation to the rate of interest which a depreciation fund can earn, but is a question of fact to be ultimately determined by physical inspection.

The diagrams following show for each of the rates specified the amount of depreciation for all the years of expectancy mentioned, and for each and every year of such expectancy. By means of these diagrams the depreciation for each particular portion of the water supply system can be computed for any given year of its life, and thus the total depreciation for the system be ascertained, provided the enterprise has a detailed statement of its property and equipment, and provided further, that the probable life of each division of the system has been ascertained by physical inspection, and that the rate of depreciation has also been determined in the same manner. In the use of these diagrams, the per cent. of depreciation at the end of any given year of the life of the part is obtained by taking an abscissa equal to the age of the part, and following the ordinate to its intersection with the curve corresponding to the total estimated or ascertained life of the part. The value of the ordinate at this point represents the per cent. of depreciation which has taken place since the construction or acquisition of the part.

The depreciation of a water supply system in a given year, calculated by deducting the net value arrived at as above at the end of a given year from the net value at the end of the preceding year, should be credited to the appropriate fixed asset accounts, and debited as depreciation or amortization to the appropriate expense accounts. When detailed information is wanting for computing depreciation, as outlined in these instructions, for each and every part of the system, it may be assumed that the aggregate depreciation for the system as a whole is approximately two per cent. of the present value of that system or two per cent. for each year since the system was acquired or constructed, of the cost of the system.

The correctness of all allowances for depreciation credited to the fixed asset accounts should be tested from time to time by physical examination of the properties as before stated. If such examination discloses the fact that the depreciation actually suffered is only slight in excess of that charged in the accounts, the extra amount may be charged to expense, as is done for ordinary depreciation. If, however, that depreciation is found to be materially greater than allowed by preceding estimates, the excess may be charged to the nominal asset account 292 "Unamortized Depreciation," and later may be charged to expense in appropriate amounts extending over such period as may be determined upon as reasonable. When the physical examination here mentioned discloses the fact that the depreciation suffered is less than the amount previously charged as expense, the excess may all be credited to account 43, "unreserved corporate surplus," if a corporation and to account 44, "unreserved proprietary interests other than corporate capital and surplus," if a municipality or a firm or individual. Further, when a physical examination discloses material variations between the amount of ordinary depreciation estimated for the past and that actually suffered, new tables or diagrams for computing current depreciation should be substituted for those given herein, such tables and diagrams to be predicated upon the results of the physical examination mentioned. Only by such change of tables and diagrams, and the resultant rates of depreciation, can a repetition of the error in accounting here mentioned be avoided.

When any fixed asset is displaced by one of the physical changes here referred to, as a replacement, renewal or betterment, the account with new construction or acquisition should give the cost of such replacement, renewal or betterment in full, in the same manner as for an addition or an original acquisition. The original account with the asset replaced, renewed or improved, should be credited by cash with the amount realized from the sale or other disposal of the displaced properties, or by the "material and supplies" account 279, "scrap' and scrap value of disused fixtures and equipment," with the estimated value of such properties; and the balance of the account, if such there be, credited by a charge as expense to one of the current depreciation accounts, or to account 292, "unamortized depreciation," according to its amount, as described in the preceding paragraph. If the amounts credited, as above and debited to cash and to "scrap and scrap value of disused fixtures and equipment," added to the preceding credits in the fixed asset accounts covering debits to expense for depreciation, exceed the original costs of the displaced asset, the excess should be debited to the balancing account 43 or 44 as the case may be. (See also note following instructions for account 69.)

Number of accounts.

When the recording of data relating to the fixed assets, as above directed, can better be done by a larger number of accounts than those provided in the accompanying classification. use may be made of such number of primary, sub-primary and additional clearing outlay accounts as may be found most convenient, provided that the classification of assets is in harmony with the one here given and the additional accounts are arranged subordinate to the general and subgeneral accounts of this scheme. As a guide to any contemplated subdivision of the subgeneral accounts, suggestions as to primary accounts are given wherever such subdivision is deemed to be important or most likely to be required, and so far as practicable, the scheme of such subdivision as herein suggested, should be adhered to.

Fixed property accounts.

The general and subgeneral fixed asset accounts with index numbers that do not end in a zero (0) are, for convenience of reference, here called fixed property accounts. They are the accounts in which are recorded financial data relating to fixed properties whose construction or acquisition has been completed and which are in use by the enterprise. These accounts record the original cost, current and prior depreciation, and present value of the properties recorded in them, and also the other data that by the foregoing descriptive statements under the title "General" are presented at the outset of instructions for fixed asset accounts. As to fixed asset accounts with index numbers ending in a zero (0), "outlays for uncompleted properties," see instructions referring to account 10.

Outlays for uncompleted properties.

The general and subgeneral fixed asset accounts whose numbers end with or contain a zero (0); are arranged primarily for keeping account of all outlays for fixed properties in process of construction. The proper account of this order should be charged with the cost of all materials purchased and received for the fixed properties, and all similar materials requisitioned from the storerooms, together with the cost of all work performed in the construction of these properties, whether by city or company employees or by contract. Outlays thus charged which at the time of charging are paid for by cash shall be debited to cash; those which are represented by audited bills should be debited to account 352; amounts due on outlay account but withheld on contarcts awaiting settlement should be debited to account 353; and outlay accounts settled and adjusted other than by cash payment should be debited to the proper subdivision of account 34. The keeping separate of the various jobs which may be running under this or similar accounts may be done by prefixing a letter of the alphabet to the account number, or by following the account number by some designated job or blue print number. When a particular construction is completed, transfer the cost thereof by proper entry to the appropriate account for complete properties in accounts 11 to 19 following.

Intangible general assets and properties.

This account is that general account in which should be summarized accounts 110 to 116.

110. Outlays for Uncompleted Intangible General Properties: In this account record all outlays indicated by its title, details of which are referred to under accounts 111 to 116, until the properties for which such outlays are made, are completed, whereupon transfer by property entry to the appropriate account for Completed Properties recorded in accounts 111 to 116, as the case may be.

111. Corporate Franchises: In this account record all fees paid to the government for the privilege of incorporation, and all costs of preparing and filing original and amendatory certificates and authorizations for increasing capital stock, and of preparing and filing papers in connection with the extension of the term of incorporation or reincorporation consequent upon reorganization. This account is for the use of privately but not of municipally operated systems. (See note following account 113 as to amortization of costs charged to this account.)

112. Operating Franchises: In this account record all payments to the city or other public authority, under any designation, which were made prior to operation for the right of using the streets of the city for the objects of the water supply enterprise, and all similar amounts paid for the extension or renewal of such rights observing in every instance any special requirements of law in the state in which the enterprise is operated with reference to accounting for such costs. This account is primarily for the use of privately operated enterprises. When cities have purchased the water supply system from a private corporation, and included in the purchase price an allowance for the operating franchises, this account should be debited with the amount so allowed. (See note following account 113 as to amortization of costs charged to this account.)

113. Preliminary Operations: In this account should be recorded all expenditures of privately or publicly owned enterprises, connected with the promotion, organization, preliminary survey, and kindred preliminary operations of the enterprise. These expenses should include all preliminary expenditures which are not covered by other accounts with fixed assets, made prior to the time the enterprise began to deliver water to customers, or for similar expenditures in connection with any extension or enlargement of the enterprise financially or physically, and for greater detail this data may be recorded in the following primary account subdivisions.

1131. Promotion, Organization and Financing Expenses (other than those to be recorded in accounts 111 and 112). See instructions for account 1136 for treatment in cases where payments are made in securities.

1132. Preliminary Engineering Expenses.

1133. Preliminary Legal Expenses (Including Counsel Fees).

1134. Injuries to Persons and Property during construction.

1135. Costs of insuring against casualties during construction or for other purposes.

1136. Interest and Commissions (i. e., interest on bonds or other evidences of indebtedness accruing during the period of construction, and all commissions or fees allowed agents or other costs of soliciting subscriptions for stock or bonds, and the actual cash value at the time of organization of securities paid agents for their services in lieu of cash for similar services, but not including discounts from their face value allowed on stock issued, or on bonds sold or other evidences of indebtedness, nor for premiums paid for the purchase of outstanding bonds or other evidences of indebtedness).

.1137. Taxes paid during the period of construction.

1138. Development Costs and Expenses. To any appraisal of the value of a water supply system, the development costs and expenses must be given due consideration, and consist principally of the following items:

Cost of changes in art and experiments,

Improvements in art and resultant costs,

Extra costs of construction due to .interference with operation,

Extra costs of piecemeal construction,

Adaptation and solidification of old system with additions,

Suppression of intangible property paid for upon consideration or other acquisition, such as earning power, franchise value, etc.,

Expenses of Corporate consolidation,

Premiums paid for securities of subsequently consolidated or otherwise acquired enterprise,

Losses of early operation,

Losses of outlying and undeveloped sections of system,

Losses of inefficient managements during early organization,

Overhead charges of enterprise during construction,

Contractors charges of enterprise during construction,

Errors in construction,

Loss and wastage of materials during construction,

Additional cost of land due to peculiar adaptability for purposes of enterprise, such as contiguity factor and costs resulting from necessity of discarding part of land purchased, necessity of discarded buildings purchased, additional costs of condemnations, etc.,

Cost of working capital,

Cost of construction funds and special deposits during construction period and early organization,

Etc., etc.,

1139. Other similar Preliminary Costs and Expenses. (See Note following)

NOTE: When the Corporate or operating franchise is a perpetual one, none of the expenditures to be recorded in accounts 111, 112 and 113 are subject to depreciation or amortization. When the franchise is for a limited period all of these preliminary expenditures for private corporations should be amortized in equal annual amounts during the years that elapse between its initial operation and the close of the franchise period. The close of any franchise period is to be taken in this connection as the close of the period of the last renewal of the franchise to which the enterprise may by law be entitled. When a city has allowed any amount for the operating franchise purchased from a private company, that allowance should be charged in account 112, and should be amortized during the period which elapses between the time of purchase and amortization of the bonds issued for securing the means of acquiring the system. Any allowance made in the same manner by a city for costs and expenses of preliminary operations is not the subject of depreciation or amortization. No other amounts to be recorded in accounts 111, 112 and 113 are subject to depreciation or should be amortized.

114. Patent Rights and Licenses: Charge to this account the cost of all rights, licenses and other intangible assets having a life of more than one year from date when placed in service, acquired by the enterprise in or under valid patent grants by the United States, to inventors for inventions and discoveries which are necessary or valuable to the economical conduct of the water business, etc. The cost of any extensions or renewals of any such patent rights and licenses shall likewise be charged to this account. These costs should be amortized in equal annual amounts during the years that elapse between the initial acquisition of the rights or licenses, and the close or end of their life.

115. Unamortized Discounts on Outstanding Stock: When stocks are sold by a private enterprise for less than face value, the amounts of discounts allowed on such stock should be charged to this account and the amount so charged should be systematically amortized and charged as expense to account 618. The period during which this amortization shall be extended should not exceed the period for which the operating franchise has been obtained. The considerations under which and the rate at which discounts on stock issued should be amortized are solely within the discretion of the corporation or that of the board of directors or management, unless provision for the proper treatment of this subject is made by law. The tendency should, however, be toward the complete amortization of such discounts at as early a date as may be possible under all the circumstances and in fairness to both the corporation and its customers.

116. Miscellaneous Intangible General Properties: To this account should be charged the cost of all intangible general properties not properly includible in any of accounts 111 to 115. The method of depreciation or amortization of such costs will depend upon the character of the properties the costs of which are here recorded.

Tangible general properties.

This account is that general account in which should be summarized the costs recorded in accounts 120 to 129. By the term general properties is meant such properties as are provided for use in connection with no specific department of the physical operation of the enterprise, or such as are provided for the general conduct of all the departments and of the enterprise as a concrete entirety.

120. Outlays for Uncompleted Tangible General Properties: In this account record all outlays indicated by its title, details of which are referred to under accounts 121 to 129, until the properties for which such outlays are made are completed, whereupon transfer by proper entry to the appropriate account for completed properties recorded in accounts 121 to 129.

121. Administrative Office Properties: Record in this account the cost of all completed properties provided for use of the president, vice-president, secretary, executive committee, directors, boards, commissioners and other officers and employees engaged in the general financial and business administration of the enterprise, the shaping of its policy, etc. (See note following account 129 as to jointly operated properties, and instructions under "general" ante, as to depreciation). Details of costs under this account may be subdivided and recorded separately in the following primary accounts:

1211. Land,
1212. Buildings,
1213. Improvements other than Buildings,
1214. Fixtures and Equipment.

122. Accounting and Commercial Office Properties: Charge to this account the cost of all completed properties used by and provided for the treasurer, auditor and comptroller of the water works enterprise, and of all other officers, clerks and employees who are engaged in computing rates, keeping account with revenue and expense, collecting bills, reading meters, inspecting water fixtures and performing similar fiscal and accounting duties. (See note following account 129 as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and recorded separately in the following primary accounts:

1221. Land,
1222. Buildings,
1223. Improvements other than Buildings,
1224. Fixtures and Equipment.

123. Business Promotion Properties: Charge to this account the cost of all completed properties used by and provided for the employees of the enterprise who are engaged in the promotion and development of water consumption. (See note following account 129 as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and recorded separately in the following primary accounts:

1231. Land,
1232. Buildings,
1233. Improvements other than Buildings,
1234. Fixtures and Equipment.

124. Operating Management Office Properties: Charge to this account the cost of all completed properties used by and provided for the general operating officers, such as General Superintendent, etc., and other employees engaged in the supervision of the general physical operation of the enterprise, of the laboratories, engineering work, store rooms and yards and in control of the general operating tools and accessories. Departmental operating office properties must be charged to the appropriate account with departmental properties. (See note following account 129 as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and recorded separately in the following primary accounts:

1241. Land,
1242. Buildings,
1243. Improvements other than Buildings,
1244. Fixtures and Equipment.

125. Laboratory Properties: Charge to this account the cost of all completed Laboratory properties, apparatus, appliances and equipment, used in conjunction with the work of analyzing water and supplies purchased for operating purposes of the enterprise, testing materials, etc. (See note following account 129 as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and recorded separately in the following primary accounts:

1251. Lands,
1252. Buildings,
1253. Improvements other than Buildings.

1254. Laboratory Apparatus and Appliances,
1255. Fixtures and Equipment.

126. Engineering Office Properties: Charge to this account the cost of all completed Engineering Office Properties, apparatus, appliances and equipment, used in conjunction with the work of designating first construction and extensions or additions thereto, and for all general engineering, designing, draughting, and general engineering inspection work, including cost or value of general maps, plans, etc. (See note following account 129 as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and recorded separately in the following primary accounts:

1261. Land,
1262. Buildings,
1263. Improvements other than Buildings,
1264. Tools, Apparatus and Appliances,
1265. Fixtures and Equipment,
1266. Maps, Plans and Records.

127. Store Room and Yard Properties: Charge to this account the cost of all completed properties used for store room and storage yard purposes, i. e., for storing and distributing to the several operating departments or to specific additions and extension jobs materials and supplies. (See note following account 129 as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account maye be subdivided and recorded separately in the following primary accounts:

1271. Land,
1272. Buildings,
1273. Improvements other than Buildings,
1274. Fixtures and Equipment.

128. General Operating Tools and Appliances: Charge to this account the cost of all general tools and appliances such as Meter testers, testing pitometers, and all tools and appliances which have more than a single use, the life of which extends over a longer period than one year. (See note following account 129 as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1281. General Tools,
1282. General Apparatus and Appliances,
1283. General Equipment and Accessories.

129. Miscellaneous General Properties: Record in this account the cost of all completed general properties not properly chargeable to any of accounts 121 to 128. (See note following this account as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in primary accounts hereunder in such manner as may be most convenient.

NOTE: In the case of properties used for jointly operated enterprises or properties used jointly for any two or more of the departments or separately accounted purposes of the same enterprise record in each appropriate account the fair proportion of the cost of such joint properties properly chargeable to each of the joint enterprises or to each department or separately accounted purpose of the same enterprise. The basis of division of such costs should be apparent upon the face of each account bearing a portion thereof. In the same manner there should be recorded in each appropriate account the fair proportion of the costs of the office equipment and fixtures, appliances, etc., of such city boards or other bodies or departments as have joint control over the water supply enterprise and other municipal enterprises or departments, and each account should clearly show the basis of such apportionment, or division of costs.

Departmental Fixed Assets: Four general accounts are provided in which to summarize the costs of departmental fixed assets of water supply systems, including the costs of land, buildings, other structures, fixtures and equipment used respectively for the collection and conveyance, purification, pumping and distribution of water.

Water supply collecting system properties.

Nine subgeneral accounts are provided for recording the costs of water diversion rights and of the land, structures, fixtures and equipment of water supply enterprises for collecting and conveying water at and from sources of supply to the purification or pumping plant, and these accounts are to be summed up in the general account 13.

In the case of enterprises obtaining water from points remote from the city, the collection system is to be considered as including all water system fixtures, appliances and structures utilized in collecting water and for conveying it from the place of its collection to the purification or pumping system, or if a purely gravity system, then to the point in or out of the city at which the enterprise begins to distribute water to customers other than to public and private water supply enterprises. In the case of enterprises obtaining water from a source located in or near the city, or near to private customers, the collecting system is here considered as including all water supply fixtures, appliances and structures connecting the sources of supply with the purification works or pumping works, whichever may be situated nearest the source of supply. In both cases mentioned the collection system is here considered as including all land upon which the structures, appliances and fixtures mentioned are located, or the rights of easement in such land; the cost of water diversion rights (as distinguished from water power rights) in perpetuity or terminable; and the cost of all buildings and other improvements upon such land, and the cost of all operating equipment used in conjunction therewith.

Of the nine subgeneral accounts mentioned, one is for recording data relating to the cost of water diversion rights (both surface and ground waters), three are for data relating to the cost of properties utilized in connection with surface sources of suply, three for similar costs of the properties utilized in connection with ground sources of supply and two for intakes and the conveyance of the water from its source to the purification or pumping plant, or to the distribution system, if a purely gravity system. In these subgeneral accounts should also be entered all information relating to the costs of amortization and depreciation, the amount of the losses on these accounts being dependent upon the period of the terminable water diversion rights, or the period of availability of the sources of supply, and in some instances the length of the franchises, as factors governing in certain cases quite as much, if not to even a greater extent than the expected life of the structures erected and used for the purpose of collecting the water supply.

130. Outlays for Uncompleted Water Supply Collecting System Properties: In this account record all outlays indicated by its title details of which are referred to under accounts 131 to 139, until the properties for which outlays are made are completed, whereupon transfer by proper entry to the appropriate account for completed properties recorded in accounts 131 to 139.

131. Water Diversion Rights: Charge to this account the cost of all water diversion rights as distinguished from water power rights, meaning thereby the cost acquiring from riparian land owners the right to divert for supply purposes the water of any stream, and from the neighboring land owners the right to draw from ground water sources of supply; also compensation and costs in connection therewith paid for abating, notifying or abandoning causes of allowable pollution of streams and ground waters used for supply; whether such rights are acquired or compensated for in perpetuity or for a definite term of more than one year. In case of annual or other periodical payments for such rights, such payments must be charged to account 621. In case of payments made for perpetual rights, the costs thus incurred are not the subject of depreciation or amortization. except to the extent of possible future abandonment of the source of supply for which the rights have been acquired, in which event the cost should be annually amortized at the rate which will have cancelled such cost at the time of the abandonment. Terminable water diversion rights costs must be amortized at an annual rate which will cover the costs expended therefor at the end of the term of the rights. All such amortization charges must be recorded as expense in account 691 and credited to this account. Details of costs under this account may be subdivided in such manner as to disclose the cost of acquiring rights in each separate source of supply, when there are several, or may be separately recorded in the following primary accounts:

1311. Perpetual Surface Water Diversion Rights.
1312. Terminable Surface Water Diversion Rights,
1313. Perpetual Ground Water Diversion Rights,
1314. Terminable Ground Water Diversion Rights.

132. Reservations: Record in this account the cost of all land for reservations along sources of supply, and also the cost of all completed buildings erected thereon and in connection therewith, such as keepers' quarters, and other structures and improvements thereon used in connection therewith, as well as all equipment, etc. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1321. Lands,
1322. Buildings,
1323. Improvements other than Buildings,
1324. Equipment.

133. Impounding Dams and Reservoirs: Charge to this account the cost of the land and all completed structures thereon used for impounding water for supply purposes at the sources of supply. (See instructions under "General" ante, as to depreciation.) Details of cost under this account may be subdivided and separately recorded in the following primary accounts:

1331. Land,
1332. Dams,
1333. Reservoirs,
1334. Buildings,
1335. Improvements other than Buildings,
1336. Equipment.

134. Lake and River Cribs: Charge to this account the cost of all land, including lake or river bed, and all completed structures thereon used for collecting water for supply purposes, keepers' quarters, etc. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately in the following primary accounts:

1341. Land,
1342. Cribs,
1343. Buildings,
1344. Improvements other than Buildings,
1345. Equipment.

135. Springs and Wells: Charge to this account the cost of the land and all completed structures thereon, used for collecting water from springs and of the wells for obtaining ground waters, including the curbing or casing of wells, but not including any equipment for pumping water from wells. Included in this account is also the cost of keepers' quarters, etc. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1351. Land,
1352. Springs,
1353. Wells,
1354. Buildings,
1355. Improvements other than Buildings,
1356. Equipment.

136. Infiltration Galleries and Tunnels: Charge to this account the cost of the land and rights of way, and all completed structures thereon and therein, used for collecting waters, also keepers' quarters and operating equipment. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1361. Land and Rights of Way,
1362. Galleries,
1363. Tunnels,
1364. Buildings,
1365. Improvements other than Buildings,
1366. Equipment.

137. Collecting Conduits and Reservoirs: Charge to this account the cost of the land and rights of way, and all completed structures thereon and therein, used for collecting water from various sources and storing in reservoirs ready for purification, pumping or distributing or for conveying to the purification or pumping plant or the distribution system (if a purely gravity system) including keepers' quarters and operating equipment. (See instructions under "General" ante, as to depreciation.) Details of cost under this account may be subdivided and separately recorded in the following primary accounts:

1371. Land and Rights of Way,
1372. Conduits,
1373. Reservoirs,
1374. Buildings,
1375. Improvements other than Buildings,
1376. Equipment.

138. Gravity Intakes and Suction Mains: Charge to this account the cost of all land and rights of way and all completed structures thereon and therein, used for the bringing of water by the means indicated by the account title, from the source of supply to the purification or pumping plant, also keepers' quarters and operating equipment. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1381. Land and Rights of Way,
1382. Gravity Intakes,
1383. Suction Mains,
1384. Suction Wells,
1385. Buildings,
1386. Improvements other than Buildings,
1387. Equipment,

138. Aqueducts and Supply Mains: Charge to this account the cost of all land and rights of way and all completed structures thereon and therein used for the bringing of water by the means indicated by the account title, from the source of supply to the purification or pumping plant, or to the distribution system (if a purely gravity system), also keepers' quarters and operating equipment. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts.

1391. Land and Rights of Way,
1392. Aqueducts,
1393. Supply Mains,
1394. Wet Wells,
1395. Buildings,
1396. Improvements other than Buildings,
1397. Equipment.

Purification system properties.

Nine subgeneral accounts are provided for recording the financial data relating to the properties employed for water purification purposes. The purification system includes all property and equipment utilized for or in connection with the purification of water, in conveying the water from one part of the purification system to another, including steam or other power plant and pumping equipment, or the proper proportion of any steam or other power plant and pumping equipment used jointly by the purification system and for the pumping system, when such power plant and pumping plant is used in connection with the delivery of wash water, for filter or sand washing, but not including any steam or other power plant and pumping equipment which is used for pumping the water supply from one part of the purification works to another. This account and the subgeneral and primary accounts thereunder is intended to include the cost of all properties utilized in any and every way for or in connection with the physical work of purifying the water supply, but in no way includes the cost of properties used for pumping water, excepting water required for washing filters, and filter sand, etc., from one point to another of the purification system. All properties utilized in connection with the pumping the water supply, or water intended for distribution to the customers of the enterprise, must be charged to the proper subdivision of account 15.

The amounts recorded in the nine subgeneral accounts under account 14 should be summed up in account 14, and may be further subdivided and separately recorded in primary accounts as indicated under the respective subgeneral accounts following.

140. Outlays for Uncompleted Purifications System Properties: In this account record all outlays indicated by its title, details of which are referred to under accounts 141 to 149, until the properties for which such outlays are made are completed, whereupon transfer by proper entry to the appropriate account for completed properties recorded in accounts 141 to 149.

141. Settling Basins: Charge to this account the cost of the land and all completed structures thereon used for the sedimentation of water without coagulation whether such sedimentation is preliminary to supply only or as a preliminary step in conjunction with the further purifications of water by some additional process. Included here are all structures used in connection with such process of sedimentation, such as keepers' quarters, valves, and connections with the succeeding step in the purification process or the mains or other means of conveyance to the pumping plant or the distribution system (if a purely gravity plant,) etc. (See instructions under "General" ante, as to depreciation). Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1411. Land,
1412. Basins,
1413. Buildings,
1414. Improvements other than Buildings,
1415. Equipment and Fixtures.

142. Coagulating Basins: Charge to this account the cost of the land and all completed structure thereon used for the coagulation of water, whether such coagulation is preliminary to supply only or as a preliminary step in conjunction with the further purification of water by some additional process, or whether used as the step in purification of water following sedimentation. This account includes properties used for sedimentation after the application of coagulant, necessary to obtain the proper action of the coagulant, and in the case of mechanical filtration, shall be considered as including the properties used in the process of purification from the point of first application of coagulant to the entrance of the water on the filters. Included here are all structures used in connection with such process of coagulation, such as keepers' quarters, coagulant mixing and storage banks,, orifice boxes and feeder equipment, valves and connections with the succeeding step in the purification process or the mains or other means of conveyance to the pumping plant or the distribution system (if a purely gravity plant), appliances for cleaning out basins, etc. (See instructions under "General" ante,, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1421. Land,
1422. Basins,
1423. Buildings,
1424. Improvements other than Buildings,
1425. Coagulant Tanks, Orifice Boxes and Feeder Equipment,
1426. Fixtures and Equipment.

143. Softening and Iron Removal Plant: Charge to this account the cost of the land and all completed structures thereon used for the process of water softening and iron removal, whether such softening and iron removal is or are preliminary or subsequent to some further or preceding process of purification or treatment of water by some additional process or processes, of whether either or both such softening and iron removal is or are the sole process of treatment of the water supply. Included here are all structures used in connection with such process of softening and or iron removal, such as keepers' quarters, and all construction, equipment and appliances connected with and forming a part of the softening and or iron removal plant, including all connections with the succeeding step in the purification process or the mains or other means of conveyance to the pumping plant or the distribution system (if a purely gravity plant), appliances for cleaning out basins, etc., used in conjunction with the plant, etc. (See instructions under "General" ante, as to depreciation.) Details of cost under this account may be subdivided and separately recorded in the following primary accounts:

1431. Land,
1432. Basins and Tanks,
1433. General Plant,
1434. Buildings,
1435. Improvements other than Buildings,
1436. Minor Plant Equipment,
1437. Fixtures and Appliances.

144. Roughing Filters: Charge to this account the cost of the land and all completed structures thereon used for roughing filtration purposes, whether such roughing filtration or scrubbing is preliminary or subsequent to some further or preceding process of purification or treatment of water by some additional process or processes, or whether such roughing filtration is the sole process of treatment of the water supply. Included here are all structures used in connection with such process of roughing filtration, such as keepers' quarters, buildings and all constructions, equipment or appliances connected with and forming a part of the succeeding step in the entire purification process, or the mains or other means of conveyance to the pumping plant or the distribution system (if a purely gravity system), appliance for cleaning or washing the filters, etc. (See instructions under "General" ante, as to depreciation.) Details of cost under this account may be subdivided and separately recorded in the following primary accounts:

1441. Land,
1442. Filters,
1143. Buildings,
1444. Improvements other than Buildings,
1445. Washing and Cleaning Equipments,
1446. Appurtenant Equipment and Fixtures.

145. Slow Sand Filters: Charge to this account, the cost of the land and all completed structures thereon used for the process of water filtration by the slow sand method, whether such filtration is preliminary or subsequent to some further or preceding process of purification or treatment of water by some additional process or processes, or whether such filtration is the sole process of treatment of the water supply. Included here are all structures used in connection with such process of slow sand filtration such as keepers' or attendants' quarters, buildings and all construction, equipment or appliance connected with or forming a part of the slow sand filtration plant, including all connections with the succeeding step in the entire purification process, or the mains or other means of conveyance to the pumping plant or the distribution system (if a purely gravity system), appliances for cleaning, scraping or washing the filters, and for washing and handling the filter sand, etc. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1451. Land,
1452. Filters,
1453. Buildings,
1454. Improvements other than Buildings,
1455. Cleaning and Sand Washing Equipment,
1456. Appurtenant Equipment and Fixtures.

146. Mechanical Filters: Charge to this account the cost of the land and all completed structure thereon used for the process of water filtration by the mechanical rapid sand method whether such filtration is preliminary or subsequent to some further or preceding process of purification or treatment of water by some additonal process or processes, or whether such filtration is the sole process of treatment of the water supply. Included here are all structures used in connection with such process of mechanical filtration, such as keepers' or attendants' quarters, buildings and all construction, equipment or appliances connected with or forming a part of the mechanical filtration plant, including all connections with the succeeding step in the entire purification process or the mains or other means of conveyance to the pumping plant or the distribution system (if a purely gravity system), mechanical and air agitation equipment together with power plant therefor, etc., but not including any portion of any coagulating equipment or chemical treatment equipment used in conjunction with mechanical filtration, except when such coagulation or chemical treatment is applied direct to the filter beds without the intervention of basis therefor. (See instructions under "General" ante, as to depreciation.) Details of cost under this account may be subdivided and separately recorded in the following primary accounts:

1461. Land,
1462. Filters,
1463. Buildings,
1464. Improvements other than Buildings,
1465. Washing and Control Equipment,
1466. Appurtenant Equipment and Fixtures.

147. Ozone Sterilizing and Aeration Plant: Charge to this account the cost of the land and all completed structures thereon used for the process of water purification or treatment by the ozone sterilizing or aeration process or method, whether such method or methods is or are preliminary or subsequent to some further or preceding process of purification or treatment of water by some additional process or processes, or whether such ozone sterilizing or aeration is or are the sole method of treatment of the water supply. Included here are all structures used in connection with such processes of ozone sterilizing and or aeration, such as keepers' or attendants' quarters, buildings and all construction, equipment or appliances connected or forming a part of the ozone sterilizing and or aeration plant, including all connections with the succeeding step in the entire purification process, or the mains or other means of conveyance to the pumping plant or the distribution system (if a purely gravity system), ozone generators and electrical equipment therefore including necessary power plant, transformers, cables, and electrical control equipment etc., but not including any portion of any chemical or other treatment equipment used in conjunction with either ozone sterilizing or aeration except when such chemical treatment is applied direct to ozone sterilizers or to the point of aeration, without the intervention of basins or other equipment therefore, (See instructions under "General" ante, as to depreciation.) Details of cost this account may be subdivided and separately recorded in the following primary accounts:

1471. Land,
1472. Ozone Sterilizers,
1473. Ozone Generators and Electric Equipment,
1474. Appurtenant Ozone Sterilizing Equipment,
1475. Aeration Structures,
1476. Aeration Equipment,
1477. Buildings,
1478. Improvements other than Buildings.

148. Chemical Treatment Plant: Charge to this account the cost of the land and all completed structures thereon used for the chemical treatment of water, whether such treatment is preliminary or subsequent to some further or preceding process of purification or treatment of water by some additional process or processes, or whether such chemical treatment is the sole method of treatment of the water supply. Included here are all buildings, equipment and appliances such as mixing tanks and gravity or pump feed apparatus, basins provided for such treatment, if any, and all connections with the succeeding step in the entire purification process, of the mains or other means of conveyance to the pumping plant or the distribution system (if a purely gravity system) but does not include any chemical treatment equipment and apparatus used in conjunction with and as an integral part of any of the methods of purification included under accounts 141 to 147, the scope of this account being to include only such chemical treatment plant which is separate from, even though an adjunct to some other method of treatment, or which is the sole method of treatment which is applied to the water supply (usually in storage or impounding reservoirs or in the transmission or distribution lines direct.) (See instructions under "General" ante, as to depreciation.) Details of cost under this account may be subdivided and separately recorded in the following primary accounts:

1481. Lands,
1482. Mixing and Application Equipment,
1483. Buildings,
1484. Improvements other than Buildings,
1485. Appurtenant Equipment and Fixtures.

149. Clear Water Basins: This account is provided for use of enterprises only which employ some system or method of purification, and to it must be charged the cost of all land, and all completed structures thereon used for the storing of water either in process of purification, as an intermediate step in the purification system, or as the final storage of purified water ready for delivery to the pumping plant or the distribution system (if a purely gravity system), and for this purpose is to be taken as a step in the process of purification or treatment as contemplated in the preceding accounts 141 to 148. The cost of basins of any character for holding water for pumping or distribution in plants which employ no process of purification or treatment must be charged to the appropriate account under general account 13. Included here are keepers' or attendants' quarters, buildings and all construction, equipment or appliances connected with and forming a part of the clear water basins, and connections from the clear water basins to the suction or wet wells for pumping or to the pumps direct, or to the supply or suction main or other means of conveyance to the pumping plant or distribution system as the case may be. (See instructions under "General" ante, as to depreciation.) Details of cost under this account may be subdivided and separately recorded in the following primary accounts:

1491. Land,
1492. Basins,
1493. Buildings,
1494. Improvements other than Buildings,
1495. Appurtenant Equipment and Fixtures.

NOTE: Whenever two or more plants or structures representing separate steps in the purification or treatment of water as included under accounts 141 to 149, are contigious and occupy portions of the same tract or parcel of land, the cost of the whole land thus occupied by the several plants should be divided in some equitable manner between the several plants in such a manner that each separate plant or each separate step in the purification process shall bear its proper proportion of the cost of the land occupied thereby and utilized thereby or applied thereto. The same principle applies in the case of a tract or parcel of land occupied by other than purification structures such as pumping stations, laboratory buildings, shops, stables, storerooms and yards, or offices, jointly with the purification system properties.

Pumping system properties.

Six subgeneral accounts are provided for recording the financial data relating to pumping system properties. These data should be recorded in the following subgeneral accounts, or should be further subdivided and recorded in the primary accounts provided as subdivisions of each of the subgeneral accounts following. For further data as to the scope of this account and its subdivisions, see instructions relating to general account 14.

150. Outlays for Uncompleted Pumping System Properties: In this account record all outlays indicated by its title, details of which are referred to under accounts 151 to 156, until the properties for which such outlays are made are completed, whereupon transfer by proper entry to the appropriate account for completed properties recorded in accounts 151 to 156.

151. Pumping Stations: Charge this to account the cost of all land and of all completed buildings and fixtures used for the pumping of water, including outbuildings, tool houses, shops, etc., and all appurtenant walks, fences, drives, and all permanently attached fixtures forming a part thereof. Whenever the pumping station and appurtenant buildings and fixtures occupy portions of the same tract of land with structures used for other departmental or accessory purposes, the cost of the whole tract of land thus jointly occupied should be divided in some equitable manner between the several departments or purposes for which the land is used in such manner that each department or other occupying purpose shall bear its proper proportion of the cost of the land so jointly occupied. (See note following account 156 as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1511. Land,
1512. Buildings,
1513. Improvements other than Buildings,
1514. Fixtures (including no apparatus properly chargeable to any of accounts 152 to 156.

152. Steam Power Pumping Plant: Charge to this account the cost of all completed properties used for the pumping of water by steam-power, but not including the buildings and other properties properly chargeable to account 151. Included here are the cost of fuel and ash handling and storage equipment, boilers and their settings, stacks and their foundations with connections to the boilers, superheaters, economizers, damper regulators and other steam economy apparatus and appliances, feed water equipment, steam and exhaust piping, steam engines, condensers and auxiliary steam apparatus such as separators, etc. pumps and pumping equipment with their foundations, and all appurtenant pumping equipment and appliances. (See note following account 156 as to jointly operated properties and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1521. Fuel and Ash Handling and Storage Equipment.
1522. Boilers and Settings,
1523. Stacks and Foundations and Connections with Boilers,
1524. Superheaters, Economizers, Damper Regulators, etc.
1525. Feed Water and Equipment,
1526. Steam and Exhaust Piping,
1527. Steam Engines, Condensers and Auxiliary Apparatus,
1528. Pumps and Pumping Equipment,
1529. Appurtenant Equipment and Appliances.

153. Hydraulic Power Pumping Plant: Charge to this account the cost of all land, other than that occupied by the pumping station and appurtenant buildings, etc., as chargeable to account 151, together with cost of all water power rights (as distinguished from water supply diversion rights), and the cost of all completed structures provided exclusively for the development of hydraulic power such as dams, head gates, canals, flumes, relief structures, and appurtenant Power generation equipment such as water wheels with control equipment and power transmission equipment from the water wheels to the pumps, including also pumps and pumping equipment, and appurtenances thereof, etc. (See note following account 156 as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1531. Land and Water Power Rights,
1532. Dams and Appurtenants Structure and Equipment.
1533. Canals, Flumes and Relief Structures and Equipment,
1534. Forebays, Wheel Fits and Power Utilization Structures,
1535. Water Wheels and Power Transmission Equipment.
1536. Governors and Other Control Apparatus,
1537. Pumps and Pumping Equipment,
1538. Appurtenant Equipment and Appliances.

154. Electric Power Pumping Plant: Charge to this account the cost of all completed properties used for the pumping of water by electric power, whether such power is purchased or generated by the enterprise itself, but not including the buildings and other properties properly chargeable to account 151. Included here are the cost of electrical generation plant and equipment, if the enterprise generates electric power exclusively for pumping and other purposes in and about the operation of a water works, of motors and electricity transmission equipment, switchboards and auxiliary electrical apparatus, pumps and pumping equipment and their foundations, and all other apurtenant pumping equipment and appliances. (See note following account 156 as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1541. Electrical Generation Plant and Equipment (for use of enterprises generating their own electric power for pumping and other water works use exclusively),
1542. Motors and Power Transmission Equipment,

1543. Switchboards and Auxiliary Electrical Apparatus,
1544. Pumps and Pumping Equipment,
1545. Appurtenant Equipment and Appliances.

155. Gas Power Pumping Plant: Charge to this account the cost of all completed properties used for the pumping of water by gas power, whether such power is obtained from purchased gas, or from gas power from producer gas plant, but not including the buildings and other properties properly chargeable to account 151. Included here are the cost of gas producer plants and apparatus, gas storage and gas transmission equipment, gas engines and power transmission equipment, pumps and pumping equipment, etc., including all machinery foundations. (See note following account 156 as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1551. Gas Producer Plant and Apparatus,
1552. Gas Storage and Transmission Equipment,
1553. Gas Engines and Power Transmission Equipment,
1554. Pumps and Pumping Equipment,
1555. Appurtenant Equipment and Appliances.

156. Miscellaneous Pumping Plant Equipment: Charge to this account the cost of all completed equipment, apparatus and appliances used in conjunction with the pumping plant, but not properly includible in any of accounts 151 to 155 and includes such items as oil filters, oily waste cleaners, station repair shop equipment, pumping engineers' office fixtures and equipment, etc. (See note following this account as to jointly operated properties, and instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in such primary accounts hereunder as may be found most useful and convenient.

NOTE: Whenever certain properties such as steam power plants, hydraulic power plants, etc., are utilized jointly for two or more enterprises operated and conducted by the same concern, such as an electric light and power plant and water works, etc., the cost of such jointly used steam power or hydraulic power plant, etc., should be apportioned between the two or more separate enterprises which make use of the same jointly, and the apportionment made to each enterprise charged to the proper accounts of each such enterprise. The basis of division or apportionment of such costs should be apparent upon the face of each account bearing such portion thereof. In such event relating to pumping plant the costs recorded under account 151 must also then be properly apportioned to each participating enterprise.

Distribution system properties.

Nine subgeneral accounts are provided for recording data relating to distribution system properties. Of these accounts, two are for recording specified data relating to transmission and storage properties and seven for distribution properties. The distribution system of a water supply enterprise consists of those properties which are utilized for the distribution of water for consumption. In the case of a water works supplying water by pumping, the distribution system consists of all water supply conveyance and utilization properties from the pumping station, or from the purification works, if the latter process follows that of pumping, to the customers' taps, or other utilization fixtures connected to the system, and in the case of water works supplying water by gravity, the distribution system consists of the properties above numerated but connecting at the end of the supply main or other means of conveyance of water from the source of supply to the distribution system, the costs of which are recorded in some appropriate subgeneral account under general account 13, or if the distribution of water to customers begins practically at the source of supply and is thence supplied by gravity, then the distribution system begins where the source of supply properties as described in subgeneral account instructions under general account 13 end. These data should be recorded in the following subgeneral accounts, or should be further subdivided and recorded in the primary accounts provided as subdivisions of each of the subgeneral accounts following:

160. Outlays for Uncompleted Distribution System Properties: In this account record all outlays indicated by its title, details of which are referred to under accounts 161 to 169, until the properties for which such outlays are made are completed, whereupon transfer by proper entry to the appropriate account for completed properties recorded in accounts 161 to 169.

161. Transmission Mains: The term transmission mains applies only in the case of water works operating pumping stations (in the case of gravity plants these mains would come under the designation of supply mains), and shall be construed to be those mains which convey or transmit water for long distances without having any connections thereto for service therefrom, from the pumping station to the distribution storage reservoir or the distribution system mains. Any mains to which service connections are made, would not come under this designation, but their cost would be chargeable to account 163, and the valves and other appliances forming part of such lines or mains would be chargeable to either account 164 or 166, as the case may be. For transmission mains, as above defined, the costs which are chargeable to this account cover cost of land and rights of way, and all completed main pipes and special castings, valves and valve vaults and boxes, regulating and other equipment and appliances, and all buildings and other structures provided for use in connection therewith. (See instructions under "General" ante as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1611. Land and Rights of Way,
1612, Main Pipes and Specials,
1613. Valves and Valve Vaults and Boxes,
1614. Appurtenant Equipment and Appliances,
1615. Buildings and Other Structures,
1616. Improvements other than Buildings and Structures

162. Distribution Storage Reservoirs, Tanks and Stand-pipes: Charge to this account the cost of all land, and the cost of all completed reservoirs, tanks and standpipes, with appurtenant buildings, structures and other improvements, apparatus appliances and equipment connected therewith, used for the storage of water preliminary to its distribution for consumption. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1621. Land,
1622. Reservoirs and Appurtenant Structures,
1623. Tanks and Appurtenant Structures,
1624. Standpipes and Appurtenant Structures,
1626. Improvements other than Buildings and Structures,
1627. Appurtenant Operating Equipment and Appliances.

163. Distribution Main Pipes and Specials: Charge to this account the cost of all land and rights of way for main pipe lines, and the cost of all completed main pipes and special castings used for the distribution of water to customers, but not including any of items properly includible in accounts 164 and 166. (Data as to the length of pipe of each diameter and the number of specials of each class and diameter in the system, and the date of their installation should be carefully kept as explained in the instructions under "General" ante, to which reference is further made as to depreciation.) Details of costs under this account may be subdivided and separately recorded in primary accounts hereunder in such detail as may be most useful, such for instance as the classification of costs under separate diameters, or the divisions of the distribution system into districts, etc., but in any such case, the total costs should be summarized in this subgeneral account.

164. Main Pipe Valves and Valve Boxes: Charge to this account the cost of all gate valves inserted in the distribution main pipes, together with the boxes over said valves, and the cost of installing the valves and boxes. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts, or if preferred, a similar subdivision under this account may be made as is mentioned in instructions relating to account 163, as may be most useful.

1641. Valves.
1642. Valve Boxes.

165. Fire Hydrants, Fire Cisterns and Connections: To this account charge the cost of all fire hydrants and fire cisterns together with the cost of the pipe, valves, etc., connecting same with the distribution main pipes, and the cost of installing same. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1651. Fire Hydrants,
1652. Fire Hydrant Connections,
1653. Fire Cisterns,
1654. Fire Cistern Connections.

166. Main Pipe Fixtures and Appliances: Charge to this account the cost of all special fixtures and appliances connected to the main pipes together with the cost of installing same, used in connection with the operation of the main pipes, such as regulating valves, air chambers, relief valves, blow-off cocks, flush plugs, etc. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1661. Regulating Valves,
1662. Air Chambers, Relief Valves, etc.,
1663. Blow-off Cocks, Flush Plugs, etc.,
1664. Other Appliances.

167. Service Pipes and Stops, owned by Enterprises: To this account charge the cost of material and labor, including all other costs and charges incurred in connection therewith, such as permit fees, repaving charges, etc., consumed in the installation of service pipes and stops from the main pipes to the customers' premises, when such costs are borne by the enterprise. When the cost is borne by the customer and the service pipes thus installed are owned by the customer, even though the enterprise may retain full control and jurisdiction thereover, these costs must be charged to account 821. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in such detail as may be most useful, but whatever such subdivision, the aggregate of the sub-accounts should be summarized in this subgeneral account.

168. Meters, Meter Boxes and Meter Vaults, furnished rent free: Charge to this account the cost of all meters, meter boxes and meter vaults, together with the cost of their installation, which are furnished on customers' service connections without charge of any character by the enterprise. Meters, etc., which are furnished subject to some periodical rental or charge should be charged to account 183, and the same costs, if the meters are furnished at the expense of the customer should be charged to account 821. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1681. Meters and Connections,
1682. Meter Boxes and Meter Vaults,
1683. Labor Costs on Meter Installations.

169. Foundations, Troughs, and Other Equipment: Charge to this account the cost of all fountains, troughs and other equipment and appliances for the utilization of the water supply by the general public, together with the cost of their connections and installation, which are installed at the cost of and are owned by the enterprise. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1691. Fountains and Connections,
1692. Troughs and Connections,
1693. Other Equipment and Appliances and Connections.

Incidental operating properties.

This account is provided for summing up the financial data relating to the cost of properties provided by the enterprise of a character which are not absolutely essential to the furnishing of water supply service, in that service for which these properties are provided is easily, and therefore often, purchased from others. Good management, however, often finds that economies are capable of being effected by and through the ownership and operation of these incidental properties, but not being operating properties of any one department of the enterprise, but such which give service to all departments, their costs are to be separately recorded. Two principal items are properly includible under this account, viz: General shops, and stables and teams, and for these two separate subgeneral accounts are provided, though additional accounts covering other possible items of the same character can readily be added to the subgeneral accounts, should in any particular enterprise there be need for such.

170. Outlays for Uncompleted Incidental Operating Properties: In this account record all outlays indicated by its title, details of which are referred to under accounts 171 and 172, until the properties for which such outlays are made are completed, whereupon transfer by proper entry to the appropriate account for completed properties in accounts 171 and 172.

171. General Shop Properties: Charge to this account all general shop properties which are not provided for and used on account of any particular department of the enterprise specifically. Included hereunder will be the cost of all land and of all completed buildings and fixtures, apparatus and equipment, such as machinery, machine tools, with drivers and connections, and all hand tools of a permanent character and other appliances used for or in connection with the operations of the general shops. (See instructions under "General" ante, as to depreciation.) Details of cost under this account may be subdivided and separately recorded in the following primary accounts:

1711. Land,
1712. Buildings and Fixtures,
1713. Improvements other than Buildings,
1714. Machinery, Apparatus and Equipment,
1715. Hand Tools and Appliances.

172. Stable and Teams Properties: Charge to this account the cost of all land and of all completed buildings, such as stables, barns and other improvements provided for and incident to the use of the stables; Teams, such as live stock, wagons, harness, etc., automobiles, bicycles, etc., and all equipment provided for hauling materials, whether used in construction work or for the running and repair of the enterprise properties, or for the conveyance of men, etc. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1721. Land,
1722. Buildings and Fixtures,
1723. Improvements other than Buildings,
1724. Live Stock,
1725. Wagons and Carts,
1726. Harness and Teams Equipment,
1727. Automobiles and Bicycles ,
1728. Equipment and Appliances.

Accessory enterprise properties.

This account is provided for summing up the costs of all lands and completed buildings and other improvements, and equipment of the enterprise not directly connected with the general management of the water supply system which are usd by quasi independent and accessory enterprises. But few water supply enterprises in the United States operate all the accessory enterprises contained in the list of subgeneral accounts hereunder, and some undoubtedly operate accessories not mentioned. Those not operating the accessory enterprises mentioned will have no use for certain accounts hereunder, and those operating enterprises contained in the list of subgeneral accounts hereunder, and and assign them names descriptive of their character other than those set forth hereunder.

180. Outlays for Uncompleted Accessory Enterprise Properties: In this account record all outlays indicated by its title, details of which are referred to under accounts 181 to 185, until the properties for which such outlays are made are completed, whereupon transfer by proper entry to the appropriate account for completed properties in accounts 181 to 185.

181. Compensated Plumbing Work Properties: When a water supply enterprise performs plumbing work for compensation, and uses a shop exclusively for such work, include in this account the cost of the land and buildings for such shop, the fixtures of such buildings, and any other improvements upon the land so used. In addition, the account should include all the equipment of the shop such as machinery, tools and accessories employed in the shop or upon the work performed by or through its instrumentality. In the case of a shop operated in a rented building, this account should record only the machinery, tools and accessories last mentioned, and if operated, as a part of the General Shop, then the costs of all machinery, tools and accessories employed in the shop should be included in account 171, and the cost of all machinery, tools and accessories used on the work should only be charged to this account. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1811. Land,
1812. Buildings and Fixtures,
1813. Improvements other than Buildings,
1814. Machinery, Apparatus and Equipment,
1815. Hand Tools and Appliances.

182. Rental Real Properties: This account is designed for recording the cost of the lands and of the improvements thereupon which are held and utilized solely or principally for the rents to be obtained therefrom. Include in this account the costs of the land and of all buildings and other improvements thereupon, and of the equipment of the buildings belonging to the enterprise not used by it in such manner as by the preceding instructions causes the cost to be recorded in the accounts of the general management or of the water supply system. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1821. Land,
1822. Buildings,
1823. Improvements other than Buildings,
1824. Fixtures and Equipment,
1825. Other Property.

183. Rental Meters, Meter Boxes and Meter Vaults: In this account record the cost of all rented meters, meter boxes and meter vaults and other appurtenant accessories. The corresponding costs of the same fixtures and appliances furnished rent free are to be recorded in account 168, and the cost of meters, meter boxes and meter vaults and appurtenant accessories which are acquired by the enterprise to be sold to or installed for and at the expense of the customer of the enterprise, are chargeable to account 821. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in the following primary accounts:

1831. Meters and Connections,
1832. Meter Boxes and Meter Vaults,
1833. Appurtenant Accessories,
1834. Labor Costs on Meter Installations.

184. Forest Lands' Service Equipment: In this account record the cost of the equipment employed in connection with the forests and other natural recources on water supply system reservations for securing an income from such forest lands and resources. The values of the landed improvements on reservations are included in account 132. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in such primary account subdivisions, with proper titles, as may be most convenient.

185. Miscellaneous Accessory Enterprise Properties: In this account record the cost of the land and of the completed improvements thereupon, and of all equipment of any minor accessory enterprise of not sufficient importance to require a separate account. Similar enterprises should be assigned specified names and the costs of their assets should be recorded in special subgeneral accounts, as described in the instructions for account 18. (See instructions under "General" ante, as to depreciation.) Details of costs under this account may be subdivided and separately recorded in such primary accounts, with proper titles, as may be most convenient.

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SOCIAL DUTIES AND PRIVILEGES OF THE ENGINEER

His Social Warfare in Foreign Countries

By CAMILLO WEISS, Member.

The problem of social position of those who represent the comparatively young technical sciences in contrast to the old, venerable faculties of law, medicine and philosophy, has always occupied many minds, especially in Europe, where rank and title take such an important part in social life, and where the holding back on principle, of the engineer for the jurist was felt as an injustice.

No office in public administration, even the most closely connected with his work, was open to him, and he was and still is generally looked upon as the helping professional hand to the superior law-school graduate. Only recently a change to the better is noticeable—thanks to the engineer's strong efforts for recognition. The last two Ministers of the Department of Public Works in Austria, were engineers, a fact unheard of until two years ago, and greeted with applause by the technical world as the first great success in conquering administrative offices. But the strife goes further: not only administration, but also diplomacy shall be open to the engineer and a powerful representation in Parliament is another aim. The German Empire plans to provide its consulates in foreign countries with technical experts. The Parliament will be asked to allow the means in the next year or two. That some national economical and law courses will have to be added to the strictly technical education, is a natural consequence.

As to the social duties of the engineer, I may quote from a lecture recently given by Professor Dr. Julius Goldstein before the "Oesterreichischer Ingenieur-und Architekten-Verein."*

"The modern technical science and with this the modern economy progressed under the emblem of the 'laisser aller', laisser faire' freeing the forces without any limit, progressed in the belief that the forces thus set free would lead themselves to social harmony. In the latter part of the nineteenth century when the technical process took more and more gigantic dimensions, the technical producing man had no time to think of himself and his social duties; instead he had to take hold of the restless, rushing development if he did not want to be pushed aside by it. In the beginning this technical process was believed to raise itself to more and more powerful forms. In this technical process the man was considered merely economical raw product, as for instance in England, about the year 1850. But the more technics interlaced with the remaining civilization, the greater and more manifold became the dangers and troubles which arose from the complicated technical apparatus.

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*Zeitschrift No. 30, of the O. I. A. V.

It was soon recognized that technics are neutral ethically and can be put into service for the good as well as for the evil. All this leads to the great and complicated problem of industrial safety which problem above all others caused the engineer to stop and think of his social duties toward mankind. With growing technics the problem of industrial safety became much more difficult than in former times, because temperatures, pressures and velocities also grew. From 1884 to 1899 almost a hundred million dollars had been paid by German contractors for accidents in industrial works. The engineers recognized it as a social duty not to depend upon insurance companies but to consider the momentum of accident prevention in constructing the machine."

But all precautionary measures fail if the workman is indifferent and careless. In order to secure real safety "the other overshadowing problem," as Mr. Reynders called it,* i. e., "the adjustment of the wage earning classes to the modern scale of undertakings" must be solved. The engineer is the missionary to the laborer. Kind explanation, tactful education and social intercedence are his eminent tasks.

I revert to Professor Goldstein's lecture: "Facing the adverse impersonal powers of modern social economy, is it at all possible for the engineer to interfere socially? The most formidable feature of social fatalism at the present time, is the belief grown to self-evidence, that a person no matter how lofty-spirited he may be ethically, cannot change conditions alone, that the ethic tune dies away unheard in the discord of social contrasts.

It must be admitted conditions grew more impersonal, relations between employer and employee more difficult and less clear and distinct, because a series of impersonal agents interceded. But just for this reason, I should think, the ethic reaction against the social fatalism arising from those conditions, ought to grow; just for this reason you must not sit with your hands folded and say: Matters are more powerful than man. In the United States the economical struggle is raging most regardlessly and yet the idea of the engineer's personal interference is a lively power.

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*The President's Annual Address.

There are many examples of all kinds of strikes and conflicts having been prevented by personal interference.

People talk of the educating influence of work; it exists only if the man can put his soul into his work and if joy and satisfaction is reflected by it so as to make man and work thrive together. But can you talk of ethical education if he has to watch the regular function of a machine?

We know that with progressing technics, work becomes exanimated for many people. We know that technics necessarily are dividing the working process into more and more single parts and assigning them to the machine. It is shown by statistics that work, done formerly by trained men, is now done by untrained women, because personal accomplishment is decreasing more and more. This is not the case in every line. There is a limited number of manufactures for whom work really has ethical value. Notwithstanding this, one can say progress of technics means exanimation and inner depreciation of labor for thousands and thousands of men.

But there is something that technics have brought which looks like a compensation and also may become one: Technics shortened working hours in general. Higher working intensity with shorter working hours."

Then the above paper deals with the elevation of the laborer's social level and the duties of the engineer in supporting it. In quoting Mr. Reynders, "there should be no needless waste of the materials entering into manufacture and construction as one of the great moral responsibilities of our profession in the future," I dare say the engineer has to fulfill social duties even towards posterity. It cannot be denied that the engineer's claim for equalization is well founded. And how is he to obtain his rights? Two ways, called the modern ones, but known since old ages, mark his tactics: Proper education of the fresh men and association to vigorous corporations. There is a danger lurking in the tendency of extreme specializing.

I again quote from the above lecture:

"The engineer, who within his technics has to treat and judge everything from the standpoint of usefulness, will, it is true, soon recognize the price of everything, but not the value of anything; he is easily tempted to form his theory of life also from technics.

The exclusive occupation of technics, with natural philosophy and mathematics pertaining to it, takes vengeance, like any one-sided occupation, in making our minds blunted for all other interests and values. Even a man like Darwin had to meet with that grevious experience. In his autobiography he writes: "Up to the age of thirty or beyond it, poetry of many kinds gave me great pleasure; formerly pictures gave me considerable, and music very great delight. But now for many years I cannot endure to read a line of poetry. I have also almost lost my taste for pictures or music. My mind seems to have become a kind of machine for grinding general laws out of large collections of facts. If I had to live my life again I would have made a rule to read some poetry and listen to some music at least once every week. The loss of these tastes is a loss of happiness, and may possibly be injurious to the intellect, and more probably to the moral character, by enfeebling the emotional part of our nature." The "cultivated engineer" ought to have not only the most extensive and exhaustive technical education, but some introduction into fine arts, history and philosophy should give the finishing touch to distinguish him from the 'skilled assistant.' Thus is the call from the old continent, thus it resounds here. President Endicott, of the A. S. C. E., wants the engineer to be educated "in all directions, to enlarge his perceptions and vision, to cultivate ideals and imaginations."

As also ex-President Eliot, of Harvard, who says: "The engineer should stand with his feet on the ground and his head in the skies."

The German universities have already answered that demand and as a result the Kaiser conferred the title of Doctor of Technical Sciences upon the graduates. A few years ago a far-sighted idea was conceived by Alexander Milleraud, the well known socialist Minister of Public Works in France. He suggested to establish a French engineering college in the U. S. to give the young French engineers an opportunity to become acquainted with American business ways. It is evident that the idea of exchanging students with foreign countries would be of even a greater advantage than the exchange of professors, which is now being carried on with Germany.

The second way to raise the professional standard, the formation of corporative powers, is already entered upon. Engineers of all nations and specialties organize into societies, the greatest being established in this country. The rigorous discrimination, in conferring the honor of membership, is one of the securities for the high plane of the profession, regulation of practice by law would be another one.

In foreign lands those societies are the headquarters of the engineer's social warfare; most every success gained there is due to their activity.

In this country the war-cry would sound premature. As yet public offices are conquered in political contest: by election, not by appointment.

However, "America appears, in fact, to be slowly but surely changing over from a democracy to a bureaucracy,"* the system adopted by the majority of constitutional governments. This system burdens the chief of the department with the responsibility; on the other hand, gives him the exclusive right of decision and to appoint his officials. He is to "judge" what is right and what is wrong; hence public opinion grants such offices to the judge, not thinking that a purely technical department demands a technical head rather than a juridicial one. In Europe this narrow minded prejudice is being overcome, though very slowly and only by embittered struggle. It could have been avoided, had publicity been enlightened in time.

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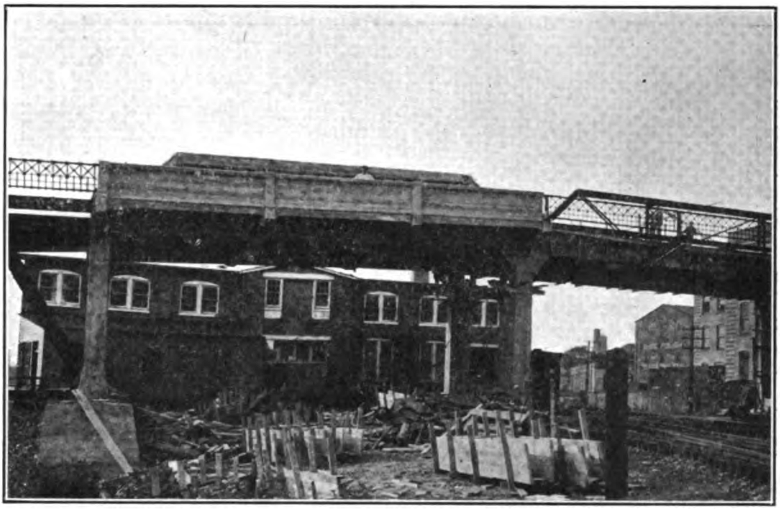
* Prof. William T. Sedgwick, in a commencement address at the Worcester Polytechnic Institute.

The American engineer may take advantage of these facts and then the dangers of bureaucracy will find him prepared and the public eye open for his social parage.

REMODELING AN OLD STEEL BRIDGE

By WM. RUSSELL SMITH, JR., Member.

Old iron and steel bridges can, in some instances, be made good reinforced concrete structures to quite economic advantage, as demonstrated in a very satisfactory way by the York County Commissioners at College Avenue Bridge in the City of York, Pa.



Remodeling College Avenue Bridge, York, Pa.

This structure with a total length of 957 feet was built in 1896 and, after being used about ten years, was condemned and closed to traffic, remaining for nearly five years an idle waste of unsightly, dangerous, deteriorating materials, thought to be worse than useless, and absolutely unsafe for people to go near.

But, owing to legal complications as private or corporate interests clashing, nothing was done until the city authorities brought suit and the court issued a mandamus order commanding the Commissioners to rebuild it. The contract was accordingly let at an actual cost to the county, to dispose of what was considered the most dangerous portion over the railroad tracks. In the meantime, various propositions were under consideration for rebuilding a new bridge at an estimated cost of over one hundred thousand ($100,000) dollars.

It was suggested that the old structure be encased in concrete at a probable cost of $25,000 or $30,000. This idea met with some favor and considerable very strenuous opposition, but was finally accepted as the best thing to be done under the circumstances.

The contract for razing the old structure at the county's expense was cancelled and one made with a local firm, the Hartley-Zeigler Company, whose bid was $23,278.00, later supplemented by one for $5,016.67 additional for making a special fill at the western approach.

The work is now nearing completion and many who were decidedly opposed to the idea at first, are among its warmest advocates, realizing, as they do, that it will soon be a very handsome and permanent structure.

The treatment required removing most of the light fabrication and incasing the principal members in concrete so reinforced as to hold it in place and make the structure much stronger than it ever was in order to meet the demands of increasing traffic and to carry the street railway. The appearance has been correspondingly improved, so as to make of it a typical piece of architecture of which the community can be proud.

The 58-foot span over the three tracks of the Northern Central Division of the Pennsylvania R. R. is about all that remains to be finished and that is well under way, so we may be able to see the old structure in its renewed form restored to use before October 1st, which is within the time limit of the contract.

This method of treating bridges has many very interesting features, especially in the arrangement of details as to reinforcement and external appearance, both of which require the greatest care and skill to insure the best possible results. But it can and will be done to a tremendous advantage all over the country.

Nature's Ten Commandments to the engineer, embracing Gravity, Chemistry, Electricity, Economy, Grace of Design, etc., must be respected in this, as in any other undertaking where no two cases are likely to be found with conditions and circumstances enough alike to make a definite description of how to do it, of much practical value, each case usually presenting its own problem to be worked out according to its peculiarities. This properly done, it is then merely a matter of the simplest application of well reinforced good concrete, and the old structure affords most of the reinforcement, besides being of considerable advantage in that it saves expensive form and centering such as are required for new work.

In this particular undertaking, it is desired to acknowledge our appreciation of the inspiring encouragement received from our fellow engineers, especially J. H. Wickersham, E. R. Seyfert, and Wilbur J. Watson, whose timely assurance to the authorities here that our plans were feasible, did much to give them courage in the undertaking, which was being ridiculed by many and suspiciously regarded as a very questionable experiment by nearly all.

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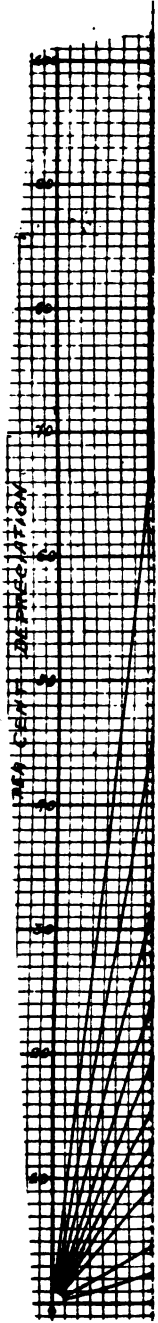

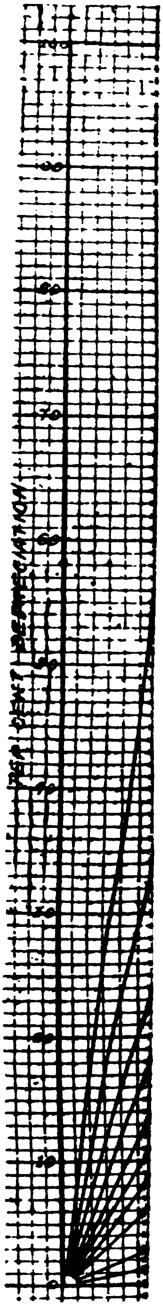

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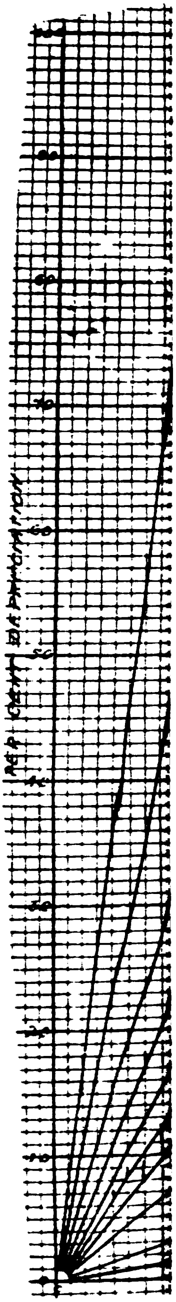
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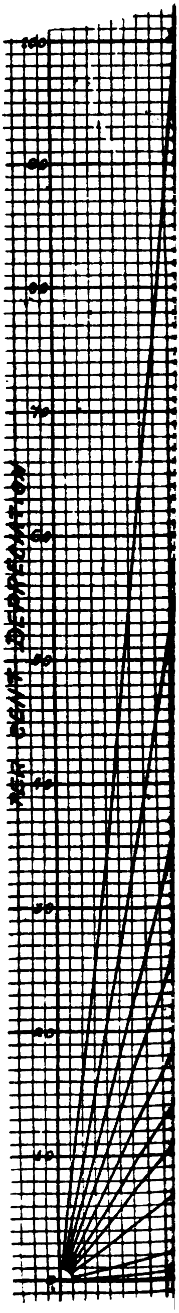
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The accompanying cut shows a typical portion of the bridge, including the unfinished span over the railroad, also the companion span finished. The main span of 208 feet over the stream being in comparatively good condition, will for the time be reinforced and repainted, but eventually it will also receive the concrete and be supported upon special arch rings to permit cutting away the upper portion of superstructure which extends above the floor level. The low part of the old steel approaches were replaced with earth fills and part of street system, up to a point where it became cheaper to apply the concrete and incase it.

UNIFORM SCHEME OF ACCOUNTS AND REPORTS FOR WATER SUPPLY ENTERPRISES.

(Third Installment.)

BY EMIL L. NUEBLING, Member.

(Being a Digest of the Report of the Committee of the American Water Works Association on the subject.)

CLASSIFICATION.

2. FLOATING AND NOMINAL ASSETS.

21. Current Cash.
    211. General Cash.
    212. Special Cash.
22. Investments.
    221. Stocks.
    222. Bonds.
    223. Other Investments.
23. Notes and Bills Receivable.
24. Revenue Debtors.
    240. Unclassified Revenue Debtors.
    241. Debtors for Metered Private Service Within City.
    242. Debtors for Unmetered Private Service Within City.
    243. Debtors for Metered Private Service Outside City.
    244. Debtors for Unmetered Private Service Outside City.
    245. Municipal and Private Water Supply Enterprises.
    246. Debtor Municipalities.
    247. Debtors of Accessory Enterprises.
    248. Accrued Revenues from Funds and Investments.
    249. Sundry Debtors.
25. Non-Revenue Debtors.
    250. Non-Classified Non-Revenue Debtors.
    251. Stockholders for Assessments.
    252. Individuals and Firm Members for Allocation of Losses.
    253. Current Transactions with City.

26. Prepaid Accounts.
    - 260. Unclassified Prepayments.
    - 261. Prepaid Insurance.
    - 262. Prepaid Rents.
    - 263. Prepaid Water Diversion Rights Charges.
    - 264. Prepaid Water Power Rights Charges.
    - 265. Prepaid Taxes.
    - 266. Prepaid Franchise Dues.
    - 267. Other Prepayments.

27. Materials and Supplies.
    - 270. Unclassified Materials and Supplies.
    - 271. Materials and Supplies in General Store Rooms and Yards.
    - 272. Materials and Supplies for General Operating Purposes.
    - 273. Materials and Supplies for Water Supply Collecting System.
    - 274. Materials and Supplies for Purification System.
    - 275. Materials and Supplies for Pumping System.
    - 276. Materials and Supplies for Distribution System.
    - 277. Materials and Supplies for Incidental Operating Properties.
    - 278. Materials and Supplies for Accessory Enterprises.
    - 279. Scrap and Scrap Value of Disused Fixtures and Equipment.

28. Reserve, Sinking and Special Funds.
    - 280. Unclassified Reserve, Sinking and Special Funds.
    - 281. Sinking Funds.
    - 282. Replacement Reserve Funds.
    - 283. Renewal Reserve Funds.
    - 284. Special Funds.

29. Nominal Assets.
    - 290. Unclassified Nominal Assets.
    - 291. Unamortized Discounts on Outstanding Debts.
    - 292. Unamortized Depreciation.
    - 293. Unamortized Losses by Casualties.
    - 294. Unamortized Extraordinary Governmental Requirements.
    - 295. Unamortized Losses by Bad Debts and Investments.
    - 296. Other Unamortized Costs and Losses.
    - 297. Contingent Assets.
    - 298. Authorized Provisions for Contractual Obligations.
    - 299. Authorized Provisions for Governmental Appropriations.

Corporate Deficit (Balancing Account).

INSTRUCTIONS FOR USE OF ACCOUNTS.

2. FLOATING AND NOMINAL ASSETS.

General: The accounts for floating and nominal assets are arranged in nine general accounts, of which accounts 21 to 27 including data relating to current assets, account 28 includes data relating to funds, with or without investments, and account 29 included nominal assets. No special accounts for summarizing these three groups or classes of floating and nominal assets account has been provided but should this be desired, the current asset accounts can be summarized in an account which can be numbered 20, and each of the other classes or groups of accounts are of themselves summarized in accounts 28 and 29 respectively.

Current Cash.

The subgeneral accounts are provided for keeping account of all cash other than that belonging to funds, which latter should be recorded in the proper subdivision under account 28.

211. General Cash: All cash received and disbursed for purposes of the enterprise, except such cash as may be accounted for in account 212 or some subdivision of account 28, must be passed through this account.

212. Special Cash: This account is provided for recording all cash "reserved" or set aside for special purposes, whether involving a trust or otherwise. This account does not, however, include any cash properly includible in any subdivision of account 28. If cash is reserved by a given enterprise for a number of purposes, the cash so set aside, instead of being recorded in a single special cash account number 212, should be recorded in a number of separate primary accounts, numbered 2121 to 2129, and given descriptive designations indicative of the purposes for which set aside or reserved.

Investments.

By investment, as here as used, is meant the cost of the enterprise's title to or interest in all properties acquired, not for use in present operation, but for the income to be derived from them, for a rise in value, for the control of some private business or other utility service, or for devotion to future operations of time when the acquisition of such properties will not be possible under such favorable circumstances. Care must be taken not to include in this account the cost of such tangible properties which are properly includible under accounts with fixed assets. Likewise stocks, bonds, or other property to which the funds of reserves such as are properly includible under some subdivision of account 28, have been invested will not be included in this account, but will be shown in the proper subdivision of account 28. Increases or decreases in values of investments recorded in this account are balanced by counter entries in account 967 or in the event of a large decrease in value of a character which constitutes a loss of such proportions as not to be fairly chargeable against profit and loss for any one period, should be balanced by the proper counter-entry in account 466. For properly recording in some detail the items charged to this account, the following subgeneral accounts are provided.

221. Stocks: Record here the cost of all stocks held as investments of the character described above, and if there are stocks of several corporations, the several holdings should be subdivided into primary accounts numbered 2211 to 2219, giving to the stockholdings in each separate corporation a separate primary account.

222. Bonds: Record here the cost of all bonds held as investments of the character described above, and if there are bonds of several corporations or municipalities, the several holdings should be subdivided into primary accounts numbered 2221 to 2229, giving to the bond holdings in each separate corporation or municipality a separate primary account.

223. Other Investments: Record here all investments as described above other than stocks and bonds. Items under this account may be subdivided in such manner as may be most convenient into primary accounts numbered 2231 to 2239, or if the amounts involved in the several kinds of investment are deemed to be sufficiently large to warrant the use of additional subgeneral accounts these may be added and numbered 224 to 229.

Notes and Bills Receivable.

Charge to this account the cost whether represented by cash, service or other article of value, of all notes and bills receivable which are the property of the enterprise and upon which solvent concerns or individuals are liable or which are sufficiently secured as to be considered good and collectible. This account includes demand notes, drafts, etc., issued by other than banks and time drafts, notes, etc., by whomsoever issued but does not include notes or bills receivable held as investments, either as includible in account 22 or 28, nor interest or dividends receivable from such investments. Any losses sustained on notes or bills receivable which have been obtained and charged to this account during the current fiscal period should be balanced by the proper entry in account 965, but any loss similarly sustained on items charged to this account previous to the current fiscal period should be balanced by proper entry in account with 465. Any subdivision of items under this account which may to each enterprise seem most convenient may be made in accounts with properly descriptive designations and numbered 231 to 239, all of which accounts, however, should be summarized in account 23.

Revenue Debtors.

The general account "Revenue Debtors" is provided for summing up the collectible portion of the uncollected revenue of an enterprise, both accrued and billed or charged but not accrued. The account is the controlling or summary account of the subgeneral account 240 to 249. In closing these subgeneral accounts at the end of any fiscal period, the appropriate accounts hereunder should be credited and account 941 debited with the amounts of such debts which the management has reason to believe will not ultimately be collected. As to debts the certainty of collection of which is reasonable and it is therefore not desirable to treat as uncollectible accounts, but yet may be considered as desirable to deduct from the profits of the period during which such debts accrued, thus to avoid the recording of profits partially uncertain of realization, see instructions as to account 465. If in the course of time, through error or otherwise, the amount of revenue debts collected exceeds the amount charged, the excess should be credited to account 767 and debited to the proper subgeneral account hereunder; and, in turn, if later it becomes certain that less will be collected than has been charged, the account last mentioned may be credited with the deficiency and the same charged to accounts 857. Such debts and credits should be accompanied with memoranda fully setting forth the character of the transactions giving rise to the same.

Subgeneral accounts 240 to 249 and this general account 24 are arranged for recording and summing up (1) the amounts of revenue that accrue or become due that have been billed or charged and will accrue or become due from customers of the enterprise; (2) the amounts of money collected and other credits allowed on the bills which have been rendered the specified classes of customers; (3) the amounts refunded to customers by reason of erroneous collection as above; and (4) the amounts collectible from the specified customers at the close of the several fiscal periods for which summaries are prepared. In keeping accounts 240 to 249 observe the following general instructions.

(*a*) When revenue bills are regularly made out in advance of the furnishing of service for which they are rendered, the appropriate account for any given class of such bills should be debited with the amount thereof. The debits in such accounts should be balanced by credit entries in other accounts, as follows: One of the subgeneral accounts 450 to 458 should be credited by the discounts allowable for prompt payment of bills, and an appropriate account either under summary account 5 "operating revenues," or under summary account 7 "miscellaneous revenues," should be credited with the net revenue due on the bills for that portion of the entire period for which the bills are rendered which lies within the fiscal period for which summaries are prepared and the balance should be credited to the appropriate class of subgeneral accounts 320 to 329. Another method of treatment, and one which may avoid any confusion which the above method may cause will be to proceed as above stated as to the charge to the appropriate subgeneral accounts hereunder and as to the credits to accounts 450 to 458, and then to credit the entire balance which represents the net revenue collectible on the bills rendered at the time of their rendition to the appropriate class of subgeneral accounts 320 to 329. The manner of subsequently treating entries to the last mentioned accounts is set forth in the instructions for account 32.

(*b*) When revenue bills are regularly rendered at the close of fixed periods and after the service has been rendered, and such bills are for a fiscal period which is equal to or less than that for which summaries of results are prepared, they should be charged to the proper subgeneral accounts hereunder, with credits for discounts allowed to accounts 450 to 458 and the balance, representing net revenue collectible, to the proper subdivisions under summary accounts 5 and 7.

(c) When revenue bills are regularly rendered at the close of fixed periods which cover the whole or parts of more than one fiscal period for which summaries of results are prepared, accounts 240 to 249 should each fiscal period be debited and the corresponding accounts under summary accounts 5 and 7 credited with such accounts as previous experience make probable have accrued on the several classes of service as net revenue. At the close of the period for which the bills are rendered, accounts 240 to 249 should be debited or credited in the appropriate column by amounts which with the debit entries previously recorded will equal the amounts of the bills rendered. The discounts allowable on the bills rendered as above described, and entries in the revenue accounts, should be recorded by credit entries as described above under (*b*).

(*d*) When bills are rendered for new or additional assessments between the beginning and close of a billing period such as is referred to under (*a*), the amounts of such bills rendered each fiscal period should be recorded by entries substantially as stated in (*a*) for bills made out at the beginning of billing periods.

(*e*) Other additions that may arise as set forth in (*d*), are those for "interest and penalties on delayed payments of bills" and "fees for shutting off and turning on." Items of this character should be kept separate from the additions referred to under (*d*) by charging their amounts to account 249, with a balancing credit entry to revenue accounts 58 or 59 as the case may be.

(f) When rebates are granted on bills rendered as described above, or the amounts of such bills are otherwise decreased before their collection, the amount of such rebate or other decreases should be recorded by credit entries in accounts 240 and 249, and by debit entries in the proper accounts under summary accounts 5 and 7 and if the rebate is for past portions of the fiscal period for which a summary is prepared, or if such rebate extends back of such fiscal period then by debit entries in account 969; but if the rebate is on some bills rendered for a future period, and is for a future period, then the amount should be credited to accounts 240 to 249 as above described, and be balanced by proper debit entries in accounts 320 to 329.

(*g*) When revenue bills are collected, accounts 240 to 249 should be credited with the fact of the bills, and cash debited with the amount of money received, and accounts 450 to 458 debited with all discounts allowed. When bills are rendered for services, which it is afterward determined to render gratuitously, then accounts 240 to 249 should be credited and account 851 "cost of gratuitous work" debited with the amounts.

(h) When revenue bills which in themselves are not erroneous have been paid in error and later refunded, cash should be credited if paid, or if payment or refund is deferred then account 344 should be credited and accounts 240 to 249 debited with the amount of all such refunds. But see instructions under account 5 for treatment of erroneous bills.

The data outlined above should be recorded in the following subgeneral accounts or should be further subdivided and recorded in the primary accounts provided as subdivisions of each of the subgeneral accounts following.

240. Unclassified Revenue Debtors: In some enterprises it may be desired to separately record data relating to certain classes of debtors included in the following subgeneral accounts, and to combine that relating to others in one account, because of the relatively few items included in such other accounts, thereby avoiding an unnecessary multiplicity of accounts. In order to reserve the uniformity aimed at in this classification, all such items which in other enterprises would belong to two or more of the following accounts, but which it may be desired to combine into one account should be recorded in this account. In this manner any class of accounts here included which may grow sufficiently to warrant being separately accounted, can readily be thereafter recorded in the proper subgeneral account following, without destroying comparability with previous periods or with the results of similar enterprises.

241. Debtors for Metered Private Service within City: Record here data as above outlined relating to private customers of metered service within the city, as distinguished from similar service to customers outside the city (enterprises which supply territory both within and outside any city or other municipal district, which do not desire to separately account for any one portion of its system as separate and distinct from any other portion of its system, should treat all its customers as being within the city, as in the title of the account contemplated). Details of data under this account may be subdivided and separately recorded in the following primary accounts:

2411. Residences.
2412. Commercial Houses.
2413. Industrial Enterprises.
2414. Churches, Schools and Charities.
2415. Miscellaneous.

242. Debtors for Unmetered Private Service within City: Record here data of the same character as should be recorded in the preceding account 241, except that includible here are only accounts for unmetered service. Details of data under the account may be subdivided in the same manner as in the case of account 241, as follows:

2421. Residences.
2422. Commercial Houses.
2423. Industrial Enterprises.
2424. Churches, Schools and Charities.
2425. Miscellaneous.

243. Debtors for Metered Private Service outside City: Record here data of the same character as should be recorded in account 241, except that includible here are only accounts for service rendered outside the city or other municipal subdivision in which the main system is located, if such outside portion of the entire system is separately accounted. Where the entire system is accounted as a concrete whole, without regard to divisional lines, there is no use for this account and it may accordingly be omitted. Details of such data under this account may be subdivided in the same manner as account 241, as follows:

2431. Residences.
2432. Commercial Houses.
2433. Industrial Enterprises.
2434. Churches, Schools and Charities.
2435. Miscellaneous.

244. Debtors for Unmetered Private Service outside City: Record here data of the same character as should be recorded in the preceding account 243, except that includible here are only accounts for unmetered service. Details of data under this account may be subdivided in the same manner as account 243, as follows:

2441. Residences.
2442. Commercial Houses.
2443. Industrial Enterprises.
2444. Churches, Schools and Charities.
2445. Miscellaneous.

245. Municipal and Private Water Supply Enterprise: Record here data relating to accounts with municipalities or private water supply enterprises, which purchase their water supply from the enterprise here accounted, for distribution to individual customers. Enterprises which do not supply water in bulk to municipalities or other water works for distribution and sale by the latter to individual customers, will have no use for the account. If the individual accounts here mentioned are sufficiently large to warrant separate accounting, this may be done by proper subdivisions hereunder into primary accounts, numbered from 2450 to 2459, reserving in such case account 2450 for the use of several accounts, if any too small to keep separate, as explained for account 240, ante.

246. Debtor Municipalities: Record here data relating to accounts with municipalities or other local governmental agencies for water supply furnished to and for use in conjunction with the governmental functions of the municipalities, etc., such as the fire departments, sewer flushing, street sprinkling and washing public schools and buildings, parks, fountains, troughs, etc. Details of data under this subgeneral account, if sufficiently large to warrant it, may be separately recorded by assigning a separate primary account to each municipality, as explained for account 245, and giving to each such primary account a proper number from 2460 to 2469.

247. Debtors of Accessory Enterprises: Record here all debit accounts of the enterprise arising from the rendering of the services of the accessory enterprises of the water supply enterprises . Detailed data under this account may be subdivided and separately recorded in the following primary accounts:

2471. Compensated Plumbing Work Debtors.
2472. Real Property Rental Debtors.

3473. Meters, Meter Boxes, and Meter Vaults, Rental Debtors.
2474. Forest Land Revenue Debtors.
2475. Miscellaneous Accessory Enterprise Debtors.

248. Accrued Revenues from Funds and Investments: Record here data relating to accrued but uncollected monies growing out of funds other than such funds as are included under account 28, except and unless the revenues from such funds are not added to and made a part of such funds, and also growing out of investments. Details of data under this account may be subdivided and separately recorded in the following primary accounts:

2481. Accrued Revenues from Funds.
2482. Accrued Returns from Investments.

249. Sundry Debtors: This account is applied for summing up the collectible but uncollected balance of accounts receivable which are in one way or another connected with the revenues of the enterprise, but are not properly includible in any of the aforegoing accounts, and include such items as accrued but unpaid charges for interest and penalties on delayed payments of water service bills, fees for shutting off and turning on, returns from the sale of scrap and other material, and any other character of account receivable not included above, and not properly includible in any of the subgeneral accounts under general accounts 25 and 28. Details of data under this account may be separately accounted in such primary accounts numbered from 2490 to 2499, as may be found to best suit the purpose of the enterprise.

Non-revenue Debtors

This account is provided for summing up the collectible but uncollected balances of accounts receivable other than those with revenue or those includible under general account 24. The accounts receivable of the character referred to that are possible for water supply enterprises are (1) those which arise between the enterprise and its stockholders, firm members or the city as owner and (2) those which arise in any manner other than in connection with the fixed asset or revenue and expert accounts. One subgeneral account is provided for recording amounts referred to under (2), and three for those referred to under (1) above. These subgeneral accounts may be added to by the use of special accounts in lieu of the one account provided in the case of (2) above, such accounts to be numbered 254 to 259.

250. Unclassified Non-Revenue Debtors: This account is provided for recording data relating to debtors of the character mentioned under instructions for account 25 as (2), and may accordingly be used to include all such accounts or items, or only such portion as may not be of sufficient importance to require separate accounts, which separate accounts, if kept, will be used as additional subgeneral accounts numbered from 254 to 259, or may be used as subdivisions under this account and given the usual primary account number, namely 2501 to 2509.

251. Stockholders for Assessments: As stated under (1) in instructions for use of account 25, this account is to be used for recording assessments on stockholders of private water supply enterprises. No use will be found for this account except in the case of private corporate enterprises which have suffered such losses as call for such assessments. When use for this account is found, and it is desired to record data hereunder in greater detail than one account will permit, these details may be separately accounted in primary accounts as subdivisions hereunder, numbered 2511 to 2519.

252. Individuals and Firm Members for Allocation of Losses: This account is for use in the same manner as account 251, except that it is intended for private enterprises owned by one or more individuals operating in their individual or associated capacity, not as a corporate entity. Subdivisions hereunder may be made into such primary accounts as may be required, to be numbered 2521 to 2529.

253. Current Transactions with City: This account will be required by municipally operated enterprises alone as explained in instructions for account 97. It should be debited with the value of all services and payments made to the city and credited with all services, material and money received from the city. This account is not used, and the entries contemplated here, whether debits or credits, are always to be recorded in account 97, unless it is the practice of the city to make settlements with its water supply enterprise by payment or collection of cash or other form of money, at stated periods, in which case the data mentioned should be carried in this account until so disposed of, either as an asset, if the account shows a debit balance or as a liability, if it shows a credit balance, but such credit balance should be transferred to account 383. Data to be recorded in this account may be subdivided in such manner as may be most convenient and shown in Primary Accounts hereunder numbered 2531 to 2539.

Prepaid Accounts.

When payments for insurance, rents, cost of water, taxes, franchises, dues, etc., are made in advance of the actual accrual thereof, the total payments thus made should be debited to this account or the proper subgeneral account hereunder. From period to period as the charges here made accrue, the proper proportion thereof should be credited here and charged the proper expense accounts. In some instances, it is necessary for proper accounting to charge to one or more such periods as expense, an estimate of the proportion of such charges which are not yet ascertained but which are nevertheless accruing. In such case charge to the proper expense accounts such estimated amounts from period to period, and credit such accounts to the proper subgeneral account hereunder, and when the total correct amount is ascertained and paid, then such total amount should be debited here. This account and the subgeneral accounts hereunder may be either assets or liabilities, according whether the balance is on the debit or credit side of the account. Any credit balance at the end of the fiscal period should be transferred to account 352 or 353, as the case may be. For convenience in recording items hereunder in greater detail, and to preserve uniformity, the following subgeneral accounts are provided.

260. Unclassified Prepayments: In some enterprises it may be desired to separately record data relating to certain classes of prepayments included in the following subgeneral accounts, and to combine that relating to others in one account, because of the relatively few items involved, thereby avoiding unnecessary multiplicity of accounts. In order to preserve uniformity as aimed at in this classification, all such items which in other enterprises would belong to two or more of the following subgeneral accounts, but which it may be desired to combine into one account, should be recorded in account 260. In this manner any class of accounts here included which may grow sufficiently to warrant being separately recorded, can readily be thereafter entered in the proper subgeneral account following, without destroying comparability with previous periods or with the results of similar enterprises. All payments when made should be debited here, and the periodical charges of the proper proportion thereof made to expense, should be credited here.

261. Prepaid Insurance: Debit this account with all insurance premiums paid, and credit by the periodical charge of the proper portion thereof to expenses.

262. Prepaid Rents: Debit this account with all rents paid, and credit by the periodical charge of the proper portion thereof to expenses.

263. Prepaid Water Division Rights Charges: Debit this account with all periodical fees and charges paid for water diversion rights, and credit by the periodical charge of the proper portion thereof to expenses.

264. Prepaid Water Power Rights Charges: Debit this account with all periodical fees and charges paid for water power rights, and credit by the periodical charge of the proper portion thereof to expenses.

265. Prepaid Taxes: Debit this account with all taxes paid, and credit by the periodical charge of the proper portion thereof to expenses.

266. Prepaid Franchise Dues: Debit this account with all franchise dues paid, and credit the periodical charge of the proper portion thereof to expenses.

267. Other Payments: Debit this account with any charges, fees or dues, not properly includible in any of the preceding accounts, which are paid, and credit the periodical charge of the proper portion thereof to expenses.

NOTE: In connection with the aforegoing accounts under general account 26, it must be borne in mind that there should be carried through the aforegoing accounts with prepayments only such amounts which cover a period of time which is longer than that period for which a statement of results is usually prepared. Thus, if the custom is to prepare monthly statements of results, and any of the aforegoing payments are for monthly periods, the monthly charges thus paid should be made direct to expenses, and not through these accounts. If the accounts of such charges are ascertained, and are made to expenses, but not paid, then said charges can be considered as accounts payable merely.

Materials and Supplies.

This account and the ten subgeneral accounts hereunder are provided for securing accounting control over those materials and supplies other than such as are acquired by the enterprise solely for use in the construction of permanent properties and equipment, or for immediate consumption in operation. Materials and supplies acquired for use in the construction of permanent properties, should be debited to the appropriate account for outlays for uncompleted properties, and those obtained for immediate consumption in operation should be charged to the appropriate expense account. When any material or supply is purchased or otherwise obtained, other than for the two purposes specified, one of the accounts 270 to 279 should be debited with the cost thereof, including freight or express charges, drayage, etc., and the same account should at a later time be credited with the cost of any quantity thereof that is used or is sold.

270. Unclassified Materials and Supplies: This account is provided for combining data relating to any two or more of the accounts 271 to 279, in substantially the same manner as is explained for the use of account 260.

271. Materials and Supplies in General Store Rooms and Yards: This account is provided for obtaining accounting control of materials passing through general store rooms and yards. Debit this account with the cost of all materials and supplies received in the general store rooms and yards, and credit with the cost of all materials and supplies that have been requisitioned or otherwise delivered to particular branches of the service for consumption in operation. The materials and supplies passing through this account may be separately accounted under such subdivisions as may be most convenient, in primary accounts numbered from 2710 to 2719. (See note following account 279.)

272. Materials and Supplies for General Operating Purposes: This account is provided for obtaining accounting control of materials and supplies acquired for ultimate, but not immediate consumption, in the operation of the branches of the enterprise properly coming under this title, such as administration offices, accounting and commercial offices, business promotion offices, general operating offices, laboratory, engineering offices, etc., as enumerated under fixed asset account 12, except general store room and yards. Debit this account with the cost of all materials and supplies received for and in the manner stated and credit with the cost of all materials and supplies originally charged to this account that have been requisitioned or otherwise delivered to and intended for immediate use in the operation of the particular office or other branch of the service named above. Convenient subdivisions of items under this account may be had by the use of primary accounts numbered from 2720 to 2790. (See note following account 279.)

273. Materials and Supplies for Water Supply Collecting System: This account is provided for obtaining accounting control of materials and supplies acquired for ultimate, but not immediate consumption, in operation of the department named, and not passing through general store rooms and yards. Debit this account with the cost of all materials and supplies received for and in the manner stated and credit with the cost of all materials and supplies originally charged to this account that have been requisitioned or otherwise delivered to and intended for immediate use in the operation of the particular department named in the title of the account. Convenient subdivisions of items under this account may be had by the use of primary accounts numbered from 2730 to 2739. (See note following account 279.)

274. *Materials and Supplies for Purification System:* This account is provided for use in substantially the same manner as explained for account 273 except as mentioned by the title. Convenient subdivisions of items under this account may be had by use of the primary accounts numbered from 2740 to 2749. (See note following account 279.)

275. *Materials and Supplies for Pumping System:* This account is provided for use in substantially the same manner as is explained for account 273 except as modified by the title. Convenient subdivisions of items under this account may be had by the use of primary accounts numbered from 2750 to 2759. (See note following account 279.)

276. *Materials and Supplies for Distribution System:* This account is provided for use in substantially the same manner as is explained for account 273 except as modified by the title. Convenient subdivisions of items under this account may be had by the use of primary accounts numbered from 2760 to 2769. (See note following account 279.)

277. *Materials and Supplies for Incidental Operating Properties:* This account is provided for use in substantially the same manner as is explained for accounts 273, in connection with the operation of the properties includible in fixed asset account 17. (See note following account 279.) Convenient subdivisions of items under this account may be had by the use of primary accounts numbered 2770 to 2779 or by use of the following primary accounts:

2771. General shop Materials and Supplies.
2772. Stable and Teams Materials and Supplies.

278. *Materials and Supplies for Accessory Enterprises:* This account is provided for use in substantially the same manner as is explained for account 273, in connection with the operation of the properties includible in fixed asset account 18. (See note following account 279.) Convenient subdivisions of items under this account may be had by the use of primary accounts, numbered from 2780 to 2789, or by the use of the following primary accounts:

2781. Materials and Supplies for Compensated Plumbing Work.
2782. Materials and Supplies for Rental Real Properties.
2783. Materials and Supplies for Rental Meters, Meter Boxes and Meter Vaults.

2784. Materials and Supplies for Forest Lands and Service.

2785. Materials and Supplies for Miscellaneous Accessory Enterprises.

279. Scrap and Scrap Value of Disused Fixtures and Equipment: This account is provided for securing accounting control over the scrap value of all discarded or disused equipment, the value of the scrap obtained from such equipment and the value of all materials, however obtained, which are sold or held for sale. Amounts debited to this account should be credited to the account with fixed assets or other assets through which or from which the scrap, etc., is obtained. Convenient subdivisions of items under this account may be had by the use of primary accounts numbered from 2790 to 2799. (See note following.)

NOTE: Complete inventories of all materials and supplies on hand should be taken at fixed intervals, and the cost of material adjusted to the lowest prevailing market cost of all such materials and supplies. Any appreciation in value of cost of such materials and supplies should be debited to the respective accounts in which the original cost of such materials and supplies were recorded, and credited to account 767, and depreciation or decline in such values of cost should be credited to the respective materials and supplies accounts in which the original cost was recorded, and debited to account 857. Such advances or declines in values or costs of materials and supplies must also be properly recorded in the statement of present values referred to in the instructions under "General" ante, relative to account I, "fixed assets."

Reserve Sinking and Special Funds.

This account and the subgeneral accounts hereunder are provided in which to record the assets set aside or reserved for some future use or purpose, such as the amortization of fixed debts, the replacement of portions of the system, the renewal of water rights and franchises, contingencies, etc. The correct method of providing for depreciation and amortization of property values, except in the case of sinking funds for the amortization of fixed debts at maturity, is to charge as expenses the amount which represents the periodical depreciation or amortization in values of such properties, and to credit like amounts to the proper accounts with fixed assets, so that at the end of the useful life of any part of the system, or at the end of any franchise, etc., the value or original cost has been completely provided for from revenue, and the property account involved shows no balance for the vanished property. In some cases, however, it is deemed to be good business policy to set aside certain funds for contingencies which may arise, because of any peculiar conditions about a particular system, or to accumulate a fund in actual cash or other form of wealth to provide for replacement or renewal of any part of a system at the end of its useful life, etc., in other words, to anticipate probable future losses. This account and the subgeneral accounts hereunder are provided for recording data relative to such special funds, which may be in process of accumulation, or which may have been completed and are being kept intact in the form of investments, or otherwise for such purposes. In such cases the procedure is to credit the periodical amount so reserved or set aside to cash or other appropriate account reflecting wealth, and to debit the appropriate subgeneral account hereunder. Additional accounts to those here provided may be added for separate accounting of several separate and distinct funds, either in additional subgeneral accounts numbered from 285 to 289, or as primary accounts under account 284.

280. Unclassified Reserve, Sinking and Special Funds: This account is provided for combining data relating to any two or more of the subgeneral accounts hereunder following in order not to disturb the general arrangement of accounts and uniformity herein, substantially as explained in instructions for the use of account 260.

281. Sinking Funds: This account is provided in which to record the assets set aside or reserved for the future amortization of the fixed debts. Separate sinking funds being accumulated for the amortization of separate issues of fixed debts, may be separately accounted in subdivisions hereunder as primary accounts numbered from 2810 to 2819.

282. Replacement Reserve Funds: This account is provided in which to record the assets set aside or reserved for the future replacement, of any fixed tangible assets of the enterprise at the end of their useful life. Separate funds hereunder may be separately accounted in primary accounts numbered from 2820 to 2829.

283. Renewal Reserve Funds: This account is provided in which to record the assets set aside or reserved for the future renewal of franchises, term water rights, and other terminable or term properties other than land and landed improvements and tangible properties owned and used in connection therewith at the end of the life thereof. Separate funds hereunder may be separately accounted in primary accounts numbered from 2830 to 2839.

284. Special Funds: This account is provided in which to record the assets set aside or reserved for contingencies, or for any special purposes not properly includible in any other of the subgeneral accounts under general account 28. Separate funds hereunder may be separately accounted in primary accounts numbered from 2840 to 2849.

NOTE: In arranging for the use of primary accounts under general account 28, instead of subdivisions recording the separate and specific funds as mentioned above, the primary accounts may be arranged to show the character of assets or forms of wealth constituting the aggregate of funds under each subgeneral accounts, as for instance (1) cash, (2) stocks, (3) bonds, (4) obligations of enterprise or municipality owning fund, (5) other forms of investment, etc.

Nominal Assets.

This general account is provided for summing up the miscellaneous nominal assets that may be recorded in the ledger and which are recorded or summed up by the ten subgeneral accounts 290 to 299. Account 290 is provided for combining items which it is desired to combine rather than separately record in two or more accounts hereunder, this to avoid multiplicity of accounts where the amounts involved are small. Accounts 291 to 296 are provided for summing up the costs accrued and the losses suffered by reason of the operation of the enterprise which for any administrative reasons are held in suspense, or in other words are not charged to or met from current revenue. These accounts are applicable only in the case of enterprises that have not accumulated a surplus reserve for the losses and costs mentioned or included therein, or unreserved surplus in amounts sufficient to meet them without disturbing the orderly payments of dividends on the part of private corporations, or in other ways embarrass a municipally conducted concern. For enterprises having sufficient surplus reserved for meeting the specified costs and losses, those costs and losses should be charged to the proper expense account the same as are all ordinary costs and losses of the same character, and the appropriate surplus reserve should be debited and the unreserved surplus credited by the amount of the specified costs and losses. For other enterprises having sufficient unreserved surplus but none reserved for the purpose of current losses, will be balanced in the profit and loss account by a reduction in the corporate surplus.

The purpose of accounts 297, 298 and 299 is explained in the instructions for the use of each of these accounts following.

290. Unclassified Nominal Assets: This account is provided for combining data relating to any two or more of the subgeneral accounts following hereunder, in order not to disturb the general arrangement of accounts and uniformity therein, substantially as explained in the instructions for the use of account 260.

291. Unamortized Discounts on Outstanding Debts: When bonds or other evidences of debt for a longer period than one year are issued and disposed of by privately or municipally operated water supply enterprise for less than their par value together with the accrued interest on the same at the time when the same takes place, the excess of such par value and accrued interest over cash value of the consideration received should be charged to this account. At or before the close of the fiscal period, thereof, a proportion of such discount, based upon the life of the security to maturity should be credited to this account and charged to sundry expense account 856, "losses on bond transactions," until the whole of the discount has been amortized or written off. The discounts on separate issues of securities may be separately accounted in primary accounts hereunder numbered from 2910 to 2919.

292. Unamortized Depreciation: All ordinary depreciation should be met each year by a charge against revenue in a depreciation expense account, and thus should never be entered in a suspense expense account. Depreciation should, however, be charged to such an account when a water supply enterprise loses one of its reservoirs by a physical disaster, or suffers any other great financial loss as the result of any physical calamity affecting the value of the property, or when its plant becomes practically valueless or decreases greatly in value by reason of the rapid increase of the city's population, which renders the plant inadequate to meet the demands upon it, and losses thus resulting are greater than should or can be charged as expense in any one year. Such losses should be faithfully recorded in the fixed asset accounts so that those accounts may reflect the value of the plant for business purposes and the shrinking of value thus reflected but not charged to expense should be recorded in the suspense account here provided.

In like manner, when physical examination of the properties of a water supply enterprise discloses the fact that the allowance for depreciation or amounts charged to expense by reason of depreciation have been too small, and that as a result the actual value of the plant is much less than the value carried on the books, the proper corrections should be made in the fixed asset account. If the depreciation thus ascertained to have taken place in excess of the previous allowance is too large to be met from a revenue in a single year, it may be charged as above to this account.

The amount charged, as above, to this account, may later be charged to current losses by depreciation in amounts and at times within the discretion of the management. (See note following account 69).

Any number or combination of numbers of large items may be separately recorded in primary accounts under this subgeneral account numbered from 2920 to 2929.

293. Unamortized Losses by Casualties: When an enterprise suffers as the result of great casualties which lead to damage to the property and person of others the amount of losses resulting from such damage should be charged to this account, unless the amount thereof be such that in the discretion of the management it may with propriety be charged against revenue for any current year. The charge should be by estimate if the loss cannot be definitely ascertained at the time of making up a statement of results. The subsequent treatment of the account is similar to those of other costs and losses held in suspense and all debts and credits which represent estimates. Any number or combination of numbers of large items may be separately recorded in the primary accounts under this subgeneral account numbered from 2930 to 2939.

294. Unamortized Extraordinary Governmental Requirements: When the city, under the terms of its operating franchise, a public utilities commission or other authority, requires a private water supply enterprise to make in any one year extraordinary expenditures that are in the nature of an expense, or when a municipally operated enterprise is required by a public utilities commission or some other branch of the municipal government to make similar expenditures, and such expenditures are so large that they cannot wisely be charged to revenue of a single year, they may be charged in part or wholly to this account.

The amounts so charged may later be charged as current expenses in amounts at the discretion of the management. Any number or combination of numbers of larger items may be separately recorded in primary accounts under this subgeneral account numbered from 2940 to 2949.

295. Unamortized Losses by Bad Debts and Investments: Both privately and publicly owned water supply enterprises rarely have any losses by bad debts or investments that cannot be met from the revenues of the current year; hence, there will seldom occur any need for holding such losses in suspense. If occasion for such action is necessary, the losses mentioned may be charged to this account. The amount so charged may later be charged to current expenses in amounts that may be deemed advisable by the management. Any number or combination of numbers of larger items may be separately recorded in primary accounts under the subgeneral account numbered from 2950 to 2959.

296. Other Unamortized Costs and Losses: Accrued costs and losses held in suspense to be charged as expense for future periods, other than those mentioned above for record in accounts 201 to 205, should be recorded in this account, either as a total in the one account or separately recorded in primary accounts under this subgeneral account numbered from 2960 to 2969.

297. Contingent Assets: To this account should be charged—(1) the value or the amount of any money or money's worth not now in the possession or control of the enterprise, which upon certain contingencies or under certain circumstances may come into its possession and control; and (2) amounts to balance other amounts entered in the account for contingent liabilities. Amounts charged to the account as in (1) should always be balanced by a corresponding amount entered in the liability account 381. When a contingent asset becomes an actual asset, as the result of any transaction or contingency, this account should be credited and the contingent liability debited to that amount and the account 766, "sundry gains," credited by cash or other assets, as the case may be. Any number or combination of numbers of larger items may be separately recorded in primary accounts in this subgeneral account numbered from 2970 to 2979.

298. Authorized Provisions for Contractual Obligations: This nominal account and the contra account 382, "Contractual Obligations," are provided for securing accounting control over the contractual obligations of private corporations operating water supply enterprises which have assumed to make specified expenditures or to cancel stated surplus reserves, as those in sinking funds for the amortization of outstanding indebtedness. Where such obligations exist, the account 382 should be credited and this account 298 should be debited at the beginning of each year with the amount of these obligations accruing during the year or other fiscal period, the same as "contingent liabilities" account is credited and "contingent asset" account is debited for any contingent liability that is assumed. Both accounts should contain itemized entries showing the amount of the obligations incurred for each purpose or object for which the good faith of the enterprise has been pledged. When the contractual obligations have been met, in whole or in part the account 382 should be debited and this account 298 credited by the amount of the obligation met. The balance of the debt account at any time will show the extent to which the obligation is still unmet. Any number or combination of numbers of large items may be separately recorded in primary accounts under this sub-general account numbered from 2980 to 2989.

299. Authorized Provisions for Governmental Appropriations: This account will be used or needed only by municipal water supply enterprises which keep complete double entry accounts at once with revenue and with appropriations. It is a contra or offset account to the credit balances of the appropriation liability, so-called, (account 383). When the appropriations are made, account 383, "governmental appropriation liabilities" should be credited and this account 299, should be debited by the amount of the appropriation, and when any expense or outlays are made, the appropriate expense or outlays or fixed asset accounts should be debited the same as are the corresponding accounts of a private enterprise, and in addition account 383 should be debited and this account 299 should be credited by the amount of the given expense or outlay.

Such number of accounts subordinate to the two accounts 299 and 383 should be kept as will coördinate the same in proper manner with the accounts with expenses and outlays and with the budget, in such primary accounts, numbered from 2990 to 2999, as may be required for this purpose. This may be done when the budget is prepared along lines which will permit of the same by carrying these accounts with liabilities in parallel columns with those of expenses and outlays. Among the separate accounts which should be so kept are those recording the contractual obligations assumed for municipally operated enterprises.

Corporate Deficit (Balancing Account).

A corporate deficit is the absence or negation of corporate surplus. In the case of a corporation it is the debit balance of account 43, and in that of governments and private owners, of account 44. This debit balance is always shown on the same side of the balance sheet as the assets, and may be spoken of as a nominal asset, being—as are most amounts given that designation—the offset to proprietary interests or nominal liabilities. In this scheme of accounts, this account has been given no number, because of the rareness with which any balance therein appears in any enterprise which is successfully operated, and then only for a relatively short time does any balance remain in this account.

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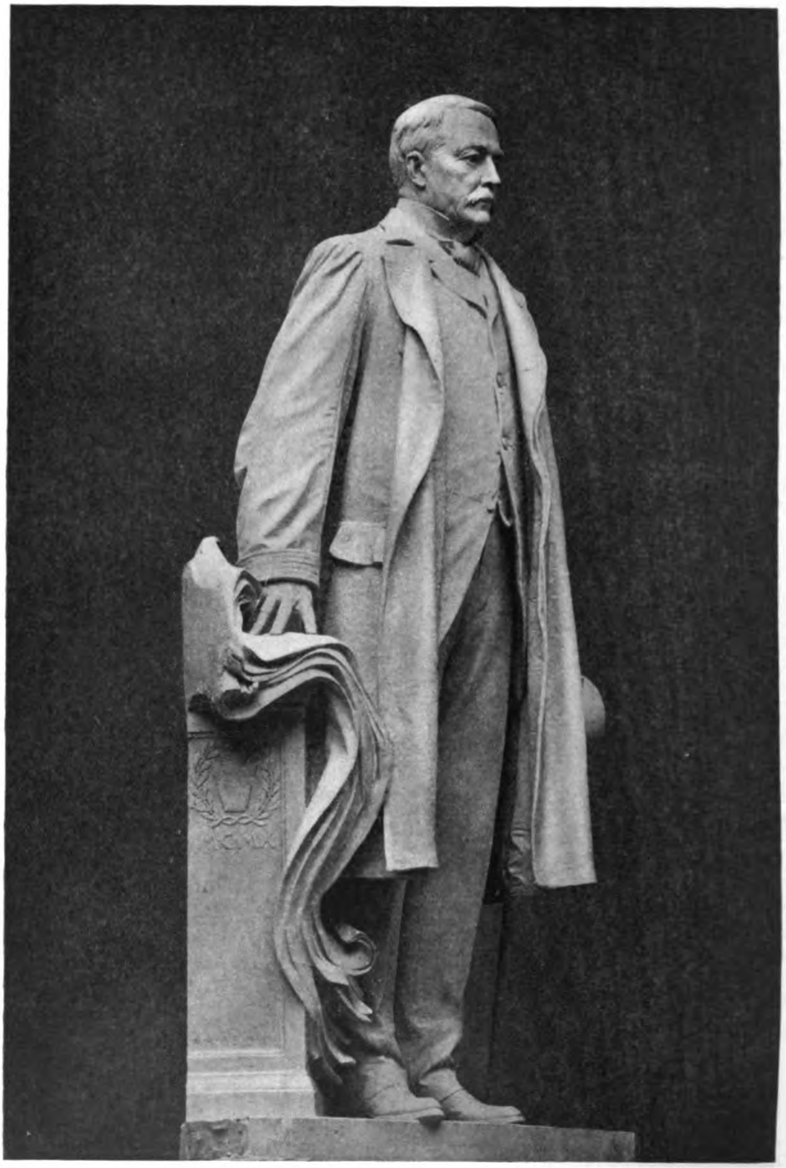

STATUE IN PENNSYLVANIA STATION.

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THE PENNSYLVANIA RAILROAD'S NEW YORK IMPROVEMENT.

By WM. B. McCALEB, Member.

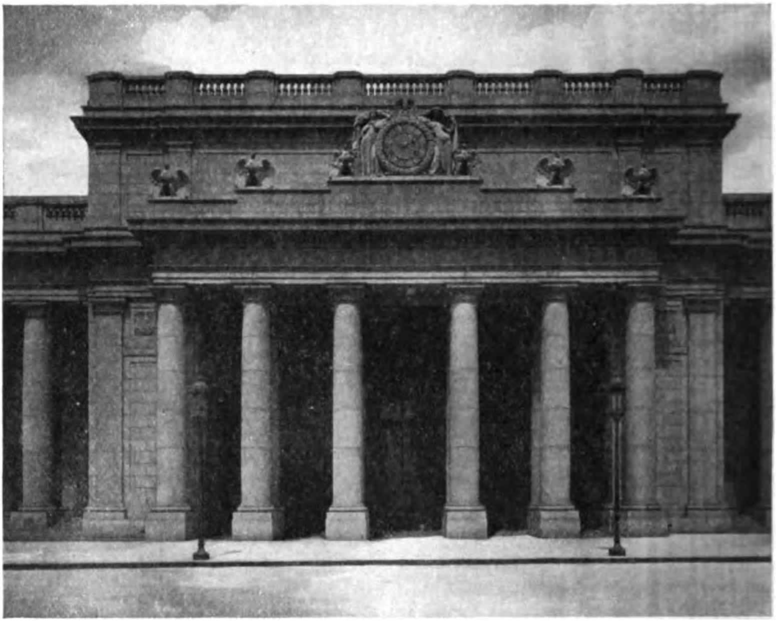
The Pennsylvania Station in New York City, at Seventh Avenue and Thirty-second Street, now completed, covers more territory than any other building ever constructed at one time in the history of the world. The Vatican, the Tuileries, the St. Petersburg Winter Palace, are larger buildings, but they have occupied centuries in their construction, The Pennsylvania Station is unique, covering as it does eight acres of ground, with exterior walls extending approximately one-half of a mile, all told, and having been erected in less than six years' time.

This Station is not only the largest structure of its kind in the world, but it epitomizes and embodies the highest development of the art of transportation. Every practicable convenience, the most ingenious of mechanical and electrical inventions, every safeguard against danger—all, in fact, that has so far been learned in railway transportation and station perfection, has been availed of for the benefit of every passenger, no matter whether he is to take a short ride to Long Island or a two thousand mile trip to the West.

While the cost of the improvement represents a greater expenditure than was ever before incurred by a private corporation for a single undertaking, nevertheless the outlay was required to unite the principal parts of the thickly populated area in and around New York City, and to provide unsurpassed facilities, in the very heart of the city, for reaching the entire country.

The idea of tunneling Hudson and East Rivers for an entrance into New York City did not evolve suddenly. It was the logical result of long-studied plans in which Mr. Alexander Johnston Cassatt, the late President of the Company, participated from the beginning, and an entrance into New York City was decided upon only when the Executive Officers and Directors of the Company realized that it had become an absolute necessity.

After the Company in 1871 leased the United Railroads of New Jersey, which terminate in Jersey City, the Officers of the Railroad looked longingly toward New York City. They wanted a station there, but they were confronted both by the great expense of such an undertaking, as well as the lack of a feasible plan, for at that time the engineering obstacles seemed to be insurmountable. The panic of 1873 made it impossible to promote any large extension or to become actively engaged in a proposition from which no immediate return could be shown; but from this time, and particularly in 1874, when the Hudson Tunnel scheme, now completed and in operation under the control of the Hudson Companies, was first started, the problem was considered. In 1884, a proposition was entertained to build the "North River Bridge" across the Hudson River, with a span almost twice that of the Brooklyn Bridge. The panic of that year, however, put a damper on all new undertakings.

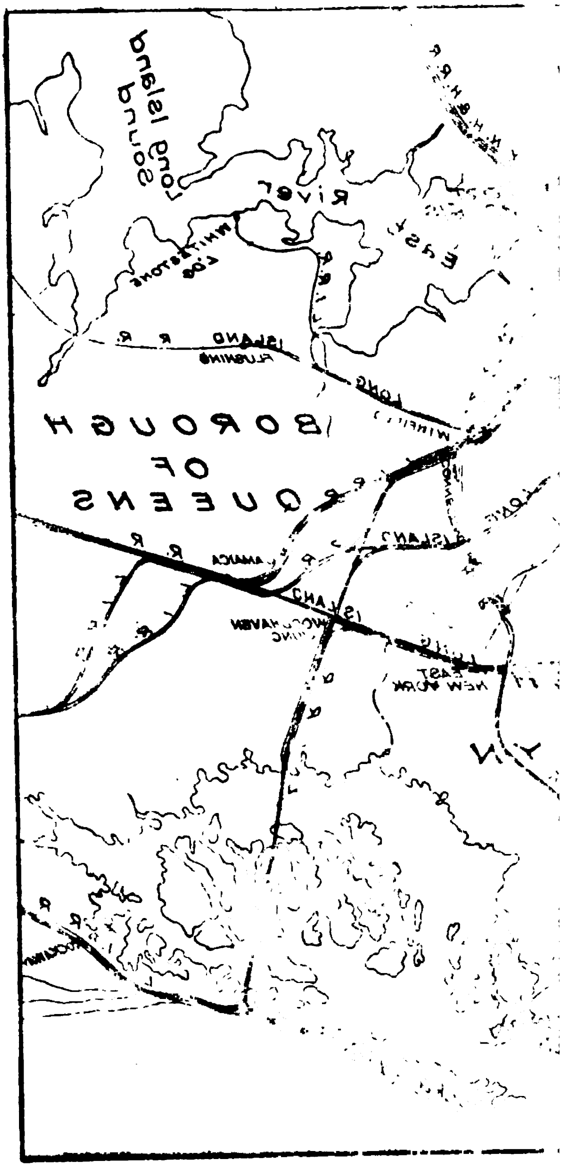


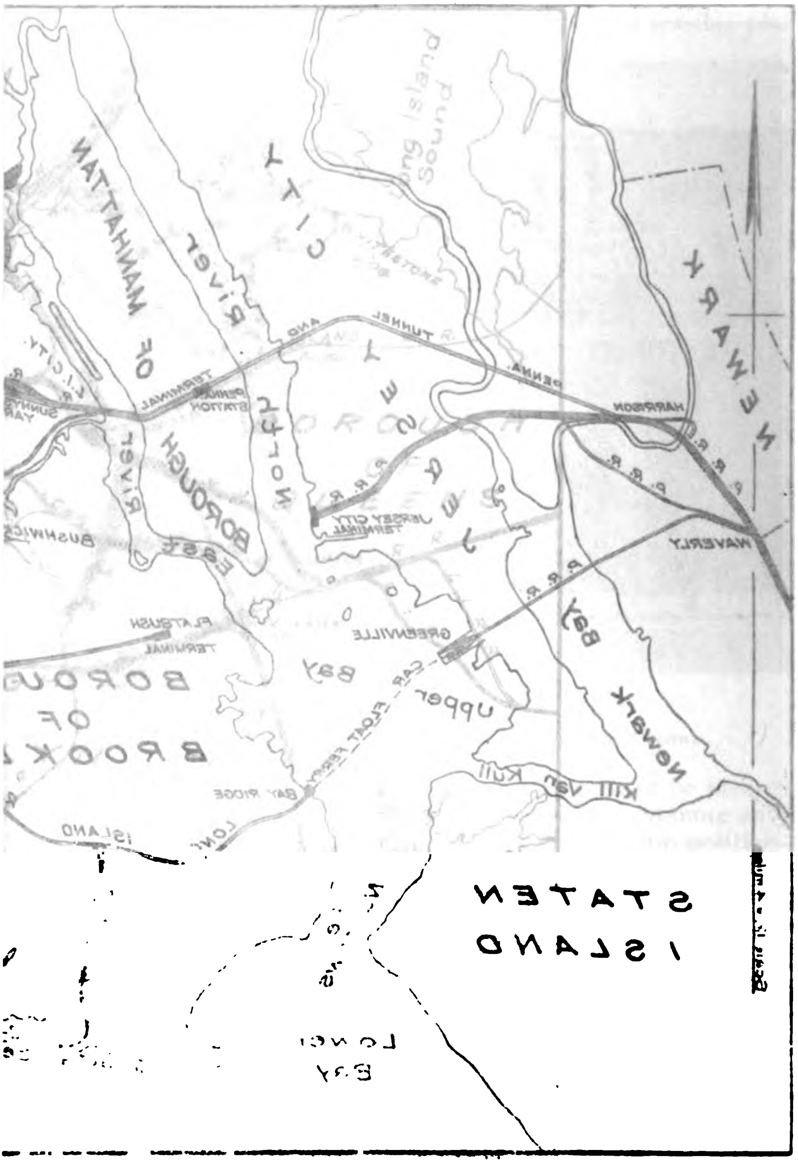
PENNSYLVANIA STATION.

Detail of Main Entrance on Seventh Avenue.

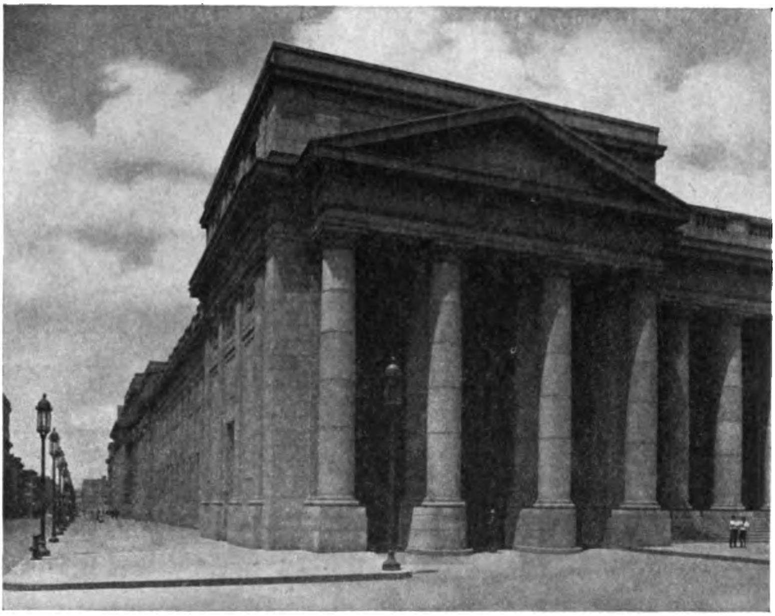
In 1892 the subject was again revived, and after careful surveys had been made, a number of different propositions were submitted, but the silver panic of 1893 prevented the adoption of any particular plan.

In 1900 the control of the Long Island Railroad was acquired by the Pennsylvania Railroad Company, and it then became desirable that the Pennsylvania should have a physical connection with the Long Island Railroad. As the other railroad lines using





ferries to carry passengers into New York City did not approve of the construction of the Hudson River Bridge, and as it was impossible to obtain a charter for a bridge to be used exclusively by a single company, a tunnel scheme was adopted by the Pennsylvania Railroad. The improvement in methods of tunnel construction, the use of electric power in tunnels, and the favorable condition of business, were the principal considerations which led to the adoption of the plan of construction which has since been carried out.



PENNSYLVANIA STATION.

Detail of Driveway Entrance, Thirty-first Street and Seventh Avenue.

In 1901 the Pennsylvania Railroad was employing ferries to land its passengers in New York City just as it did in 1871, when it first leased the United Railroads of New Jersey.

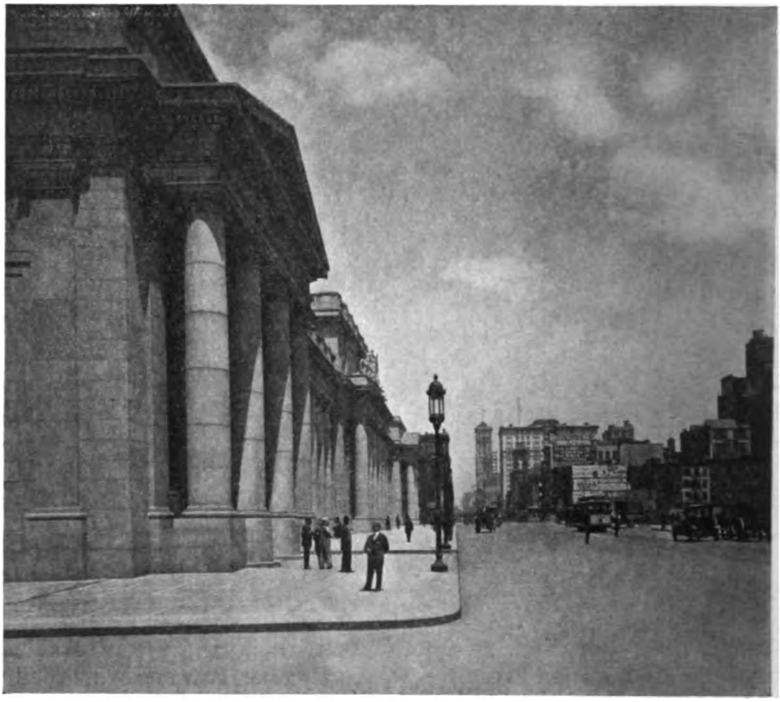
Railroads on the western bank of the Hudson River opposite New York City carried, in 1886, nearly 59,000,000 people. In 1890 they carried over 72,000,000, in 1896 more than 94,000,000 and in 1906 about 140,000,000 people.

In 1890 the population gathered within a circle of 19 miles radius, with City Hall, Manhattan, as the center, was 3,326,998; in 1900 it was 4,612,153, and five years later it was 5,404,638, an increase in ten years of 38 per cent. In 1913 it is estimated that the population of this territory will approximate six million people and 1920 eight million.

These startling figures, and what they meant in transportation needs, in addition to the serious problem of providing corresponding freight facilities, were considered when the Pennsylvania

Railroad was contemplating entering New York City. It was evident that one of the greatest transportation problems in history was rapidly evolving, and it was only by quick action that the Railroad could prepare to cope with it.

With the traffic in and out of New York City growing more rapidly than it had during any period in the last twenty years, the question confronting the Management of the Railroad was whether the volume of this traffic was such as to warrant any other method of transportation than ferries for crossing the North and East Rivers. The action taken by the Pennsylvania Railroad shows how it met this situation, and the result is the New York Station and Tunnel Extension.

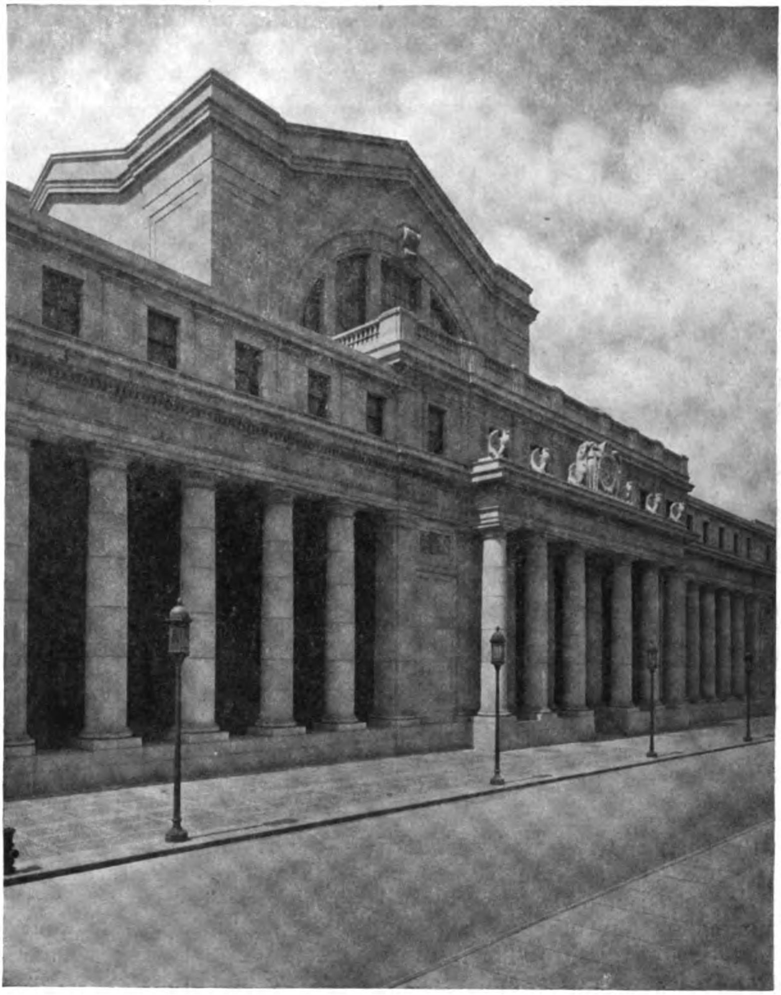


PENNSYLVANIA STATION.

Seventh Avenue Facade looking North from Thirty-first Street

There were many reasons for the construction of this great improvement. The Company desired to provide for the future by enlarging the present facilities for freight and passenger traffic, because of the continuous growth in this traffic. To accomplish this before the cost became almost prohibitive, or the task impossible because of the construction of other underground transportation lines, meant that no time should be lost.

It was the Company's plan to run its passenger trains into a centrally located station in the city of New York, instead of on the western bank of the Hudson River; to give rapid transit from the residential sections of Long Island, and to offer to Newark and other cities in New Jersey, direct and quick access to New York City, and to the resorts on Long Island beaches.



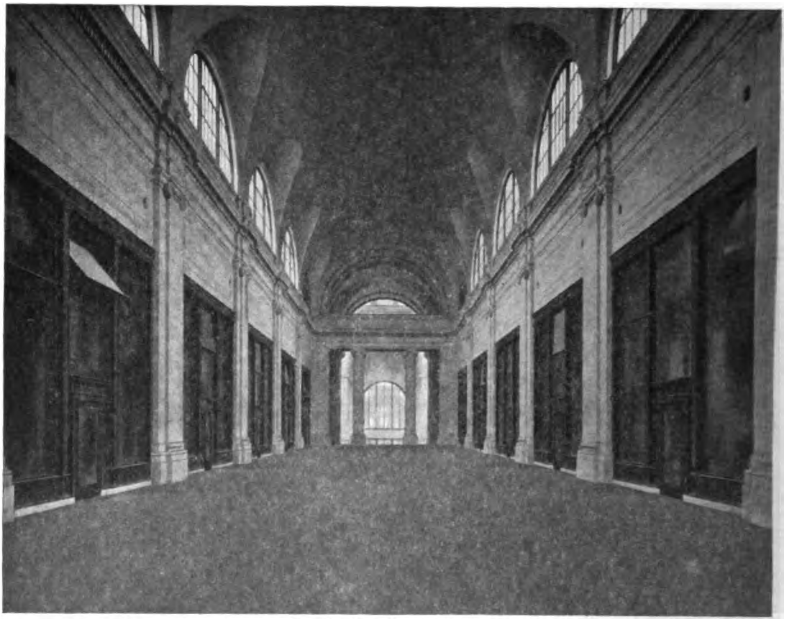
PENNSYLVANIA STATION.

Detail of Thirty-third Street Entrance to Main Waiting Room.

It was considered essential to provide an all-rail connection between the South and West on the one hand, and New England and the East on the other. The Company desired to give to the Boroughs of Brooklyn and Queens, with their population of over 1,500,000, direct railroad connections to and from the New England, Southern and Western States, and to supply freight facilities with similar connections in these Boroughs, with freight stations suitably located to develop their commercial interests.

It was planned to provide additional freight facilities, and, by the use of the Long Island Railroad, to shorten the water transportation trip for the New England traffic across New York Harbor from twelve to three and four-tenths miles.

The Company considered it its duty to obtain a proper share of the golden future by judicious expenditures in a territory having abundant promise, whether viewed from the growth of traffic in the past, or the outlook for the future.



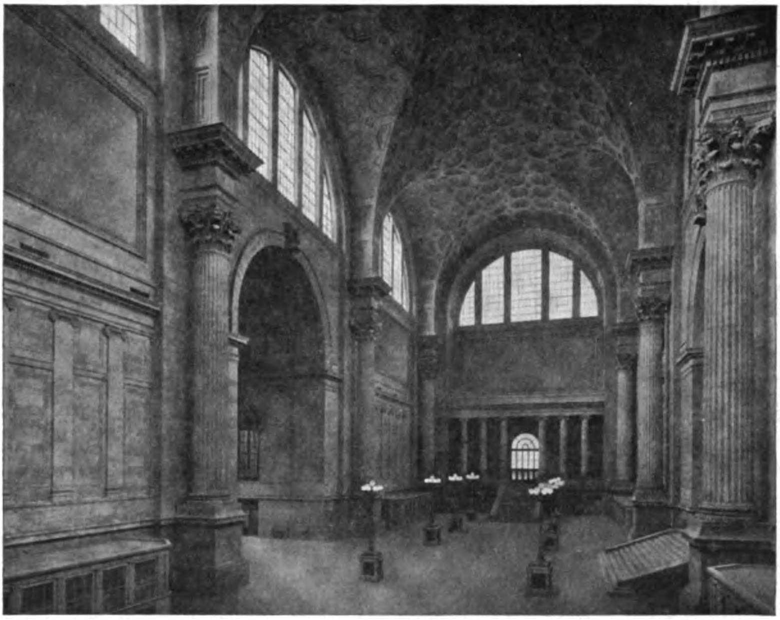
PENNSYLVANIA STATION.

The Arcade, looking from the Seventh Avenue Entrance toward the Main Waiting Room.

Built after the Roman Doric style of architecture, the New York Station of the Pennsylvania Railroad covers the entire area bounded by Seventh and Eighth Avenues and Thirty-first and Thirty-first Street to Thirty-third Street, the Seventh Avenue is 799 feet 11¼ inches, and the length of the building is 788 feet 9 inches, thus allowing for extra-wide sidewalks on both side streets and avenues. The walls extend 430 feet 6 inches from Thirty-first Streets to Thirty-third Street, the Seventh Avenue facade signalizing the main entrance.

While the facades of the station were designed to suggest the imposing character of the ancient Roman temples and baths, the impression intended to be made upon the layman approaching the Station, in full view of the exterior of the general waiting room with its huge semi-circular windows, is that of one of the leading railway stations of the world.

In designing the exterior of the building, Messrs. McKim, Mead & White, the architects, were at pains to embody two ideas: To express in so far as it was practicable, with the unusual condition of tracks below the street surface and in spite of the absence of the conventional train shed, not only the exterior design of a great railway station in the generally accepted form, but also to give to the building the character of a monumental gateway and entrance to a great metropolis.



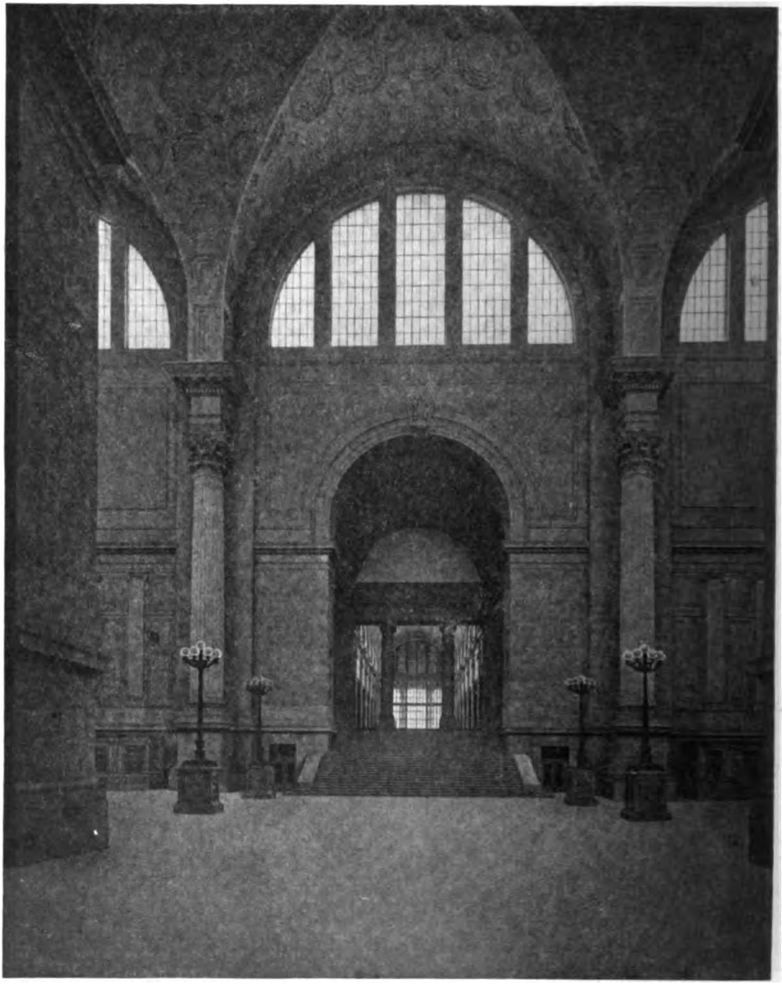
PENNSYLVANIA STATION.
General View of Main Waiting Room.

Apart from these two fold ideas, the plan of the Station was designed to give the greatest number of lines of circulation. The structure is really a monumental bridge over the tracks, with entrances to the streets on the main axis and on all four sides. In this respect the building is unique among the railway stations of the world, affording the maximum of entrance and exit facilities.

The Seventh Avenue facade is composed principally of a Roman Doric colonnade, double at the carriage entrances at the street ends and at the main front entrance for pedestrians in the center; each of the columns is 4 feet 6 inches in diameter and 35 feet high. Above the central colonnade is an entablature surmounted by a clock with a dial 7 feet in diameter. The center of this clock is on the axial line of thirty-second Street, and 61 feet above the sidewalk.

is on the axial line of thirty-second Street, and 61 feet above the sidewalk.

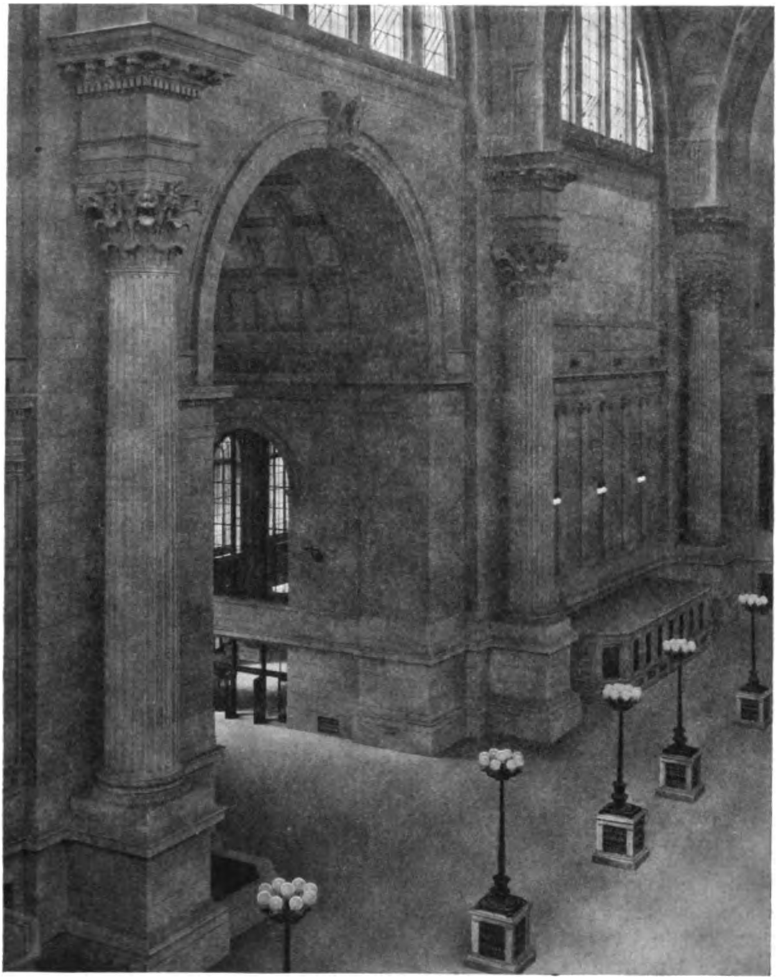
This Seventh Avenue facade was conceived especially to symbolize in the most imposing fashion a monumental gateway. It may be compared, with due allowance for its more massive proportions, to the Brandenburg Gate in Berlin, through which passes so much of the traffic of that city. The central entrance on Seventh Avenue leads to the main waiting room through an arcade 225 feet long by 45 feet wide, flanked on both sides by shops. At the farther end of the arcade are the restaurants, lunch rooms and cafe, and beyond are the general waiting room and concourse, the latter being on the first level below the street.



PENNSYLVANIA STATION.

View of Main Waiting Room, looking from Entrance to Concourse toward Seventh Avenue, showing Grand Stairway.

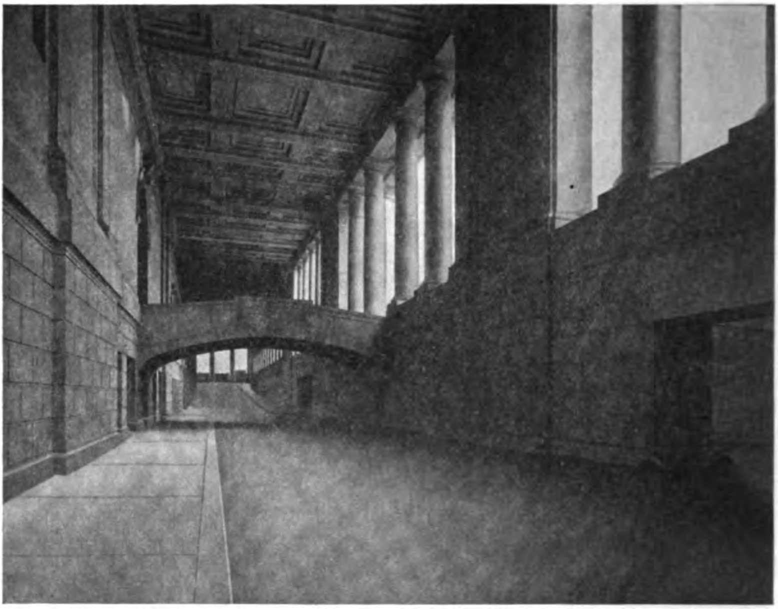
The main body of the building approximates in height the Bourse of Paris, reaching 76 feet above the street level. With entrances through the two corners of the Station on Seventh Avenue there are carriage drives, each about 63 feet wide, or almost twice the width of a standard New York City street, fronted by double columns and pediments. The narrowest opening between the columns is practically equal in width to the arched driveways in the Louvre, through which the omnibuses of Paris pass. The frontage is the same on Thirty-first and Thirty-third streets. The walls of the exterior of the carriage drives are of pilaster treatment for a distance of some 279 feet.



PENNSYLVANIA STATION.

Detail of portion of the West Wall, Main Waiting Room, looking toward Concourse.

The central features of the facades of the Thirty-first and Thirty-third Street sides for a distance of about 230 feet are formed by a colonnade opening into the carriage driveways below. Over the central porticoes of the colonnades are ornamental clocks and eagles, similar to those in the Seventh Avenue front. From the opening in the center, bridges for the use of foot passengers entering from the street level lead directly over the carriage driveways to the general waiting room. West of these carriage courts, and along the Eighth Avenue front, the general scheme of design is continued by the use of pilasters in place of columns, except at the three entrances to the concourse and offices. This entire section of the building is composed of four stories of offices given over to the use of the local executive staff of the Railroad Company.



PENNSYLVANIA STATION.

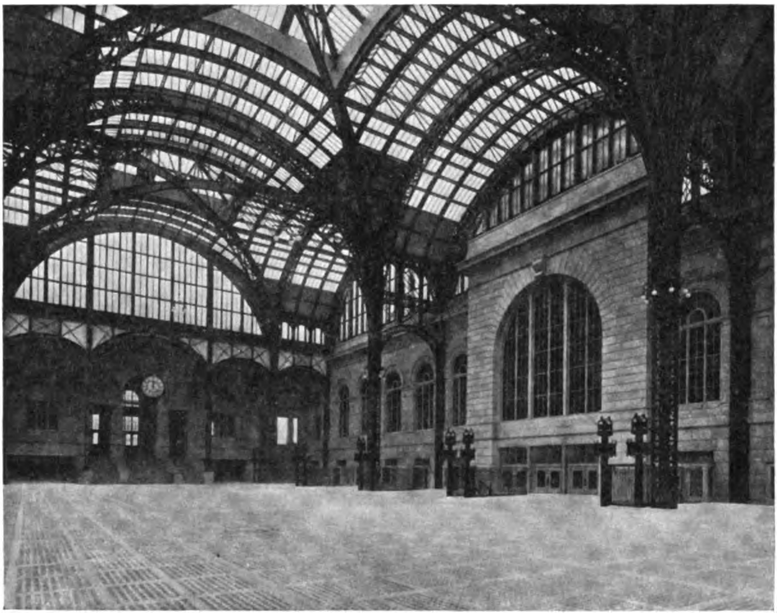
Exit to Thirty-third Street from Main Waiting Room, showing Doors leading to the Driveway.

The Eighth Avenue frontage is treated on the plan of pilasters except for 44 feet 6 inches; this part is broken by columns into intervals of three spaces to mark another spacious entrance to the main floor of the concourse.

One of the distinctive features of this building is the waiting room, which extends from Thirty-first street to Thirty-third Streets, its walls parallel to Seventh and Eighth Avenues for a distance of 314 feet 4 inches. The height of this room is 150 feet and its width 108 feet 8 inches. The walls of the waiting room above the main body of the building contain on each side three semi-circular windows of a radius of 33 feet 4 inches, and 66 feet 8 inches wide at the base. There is also a window of like size at each end of the waiting room.

The dignified design of the interior of the waiting room, while fully adapted to modern ideas, was suggested by the great halls and basilicas of Rome, such as the baths of Caracalla, Titus and Diocletian, and the basilica of Constantine, which are perhaps the greatest examples in history of large roofed-in areas treated in a monumental manner.

The main waiting room on the concourse level is the largest in the world. Within its walls are located the ticket offices, baggage checking windows, and telephone and telegraph offices, so conveniently arranged that a passenger may proceed from one to the other with a minimum amount of exertion and without retracing his steps. Adjoining the general waiting room on the west side are waiting rooms, each 58 by 100 feet, for men and women. These open into retiring rooms.



PENNSYLVANIA STATION.

Concourse, looking toward Thirty-third Street, showing Train Gates and Indicators.

The grand stairway, 39 feet 6 inches wide, is constructed of Italian "Travertine" stone. It leads from the arcade into the general waiting room, and from it one gets a view of the main entrance to the arcade and of the entire waiting room. At the head of this stairway, in the Travertine wall is placed the statue of Alexander Johnston Cassatt, the dominant personality in the Pennsylvania Railroad Tunnel and on station project. No greater tribute could be paid to his genius than the inscription at the base of the statue, which reads as follows:

Alexander Johnston Cassatt
President Pennsylvania Railroad Company
1899 1906
Whose Foresight, Courage and Ability
Achieved the Extension of the
Pennsylvania Railroad System into
New York City.

The statue is the work of Adolph Alexander Weinman, the sculptor.

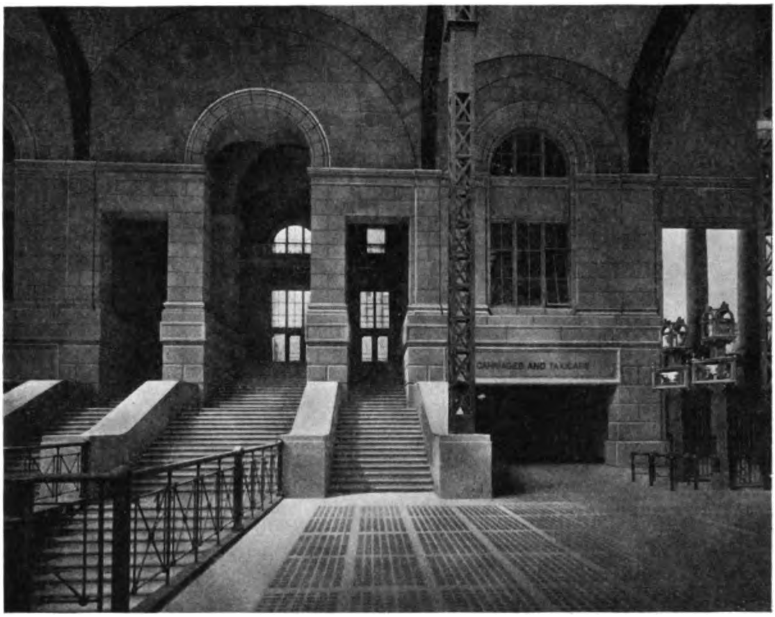
The Roman Travertine used in the arcade and general waiting room of the station for the walls, and for all columns, pilasters and stairways, comes from the quarries of the Roman Campagna, near Tivoli, Italy. It is the stone of which imperial and modern Rome is principally built, these quarries having supplied the major part of the building stone of Rome for many centuries. Notable examples of its use are the Coliseum and St. Peter's Cathedral. It was imported into this country for the first time by the Pennsylvania Railroad Company for use in the Pennsylvania Station in New York.

Travertine stone was used in the construction of the Station for the reason that while it is very hard and durable, it has an openness of texture which makes it particularly suitable for use in areas of such unusual dimensions as the Pennsylvania Station, giving a character and distinction to the surface which could not be obtained with a stone of more uniform appearance. Moreover, the stone tends to take a polish when rubbed up against, rather than absorb dirt, which makes it very practical for public station uses. Its warm, sunny, yellow color is pleasing, and in this respect it is distinctly superior to almost any of the stones available in the North American continent, which are, as a rule, of a cold gray color. Through the use of this stone, the general waiting room has a mellowness of tone which is very noticeable, even on the cloudiest days.

The main baggage room, with 450 feet of frontage, is located on the same level with the general waiting room. This is for inbound and outbound baggage carried by cabs and transfer wagons, and covers the full area occupied by the arcade and restaurants on the plane above. Baggage is delivered to and taken from trains through a special subway. From the baggage room trunks are delivered to the tracks below by motor trucks and elevators. Motor cabs will also be stationed on this level.

Parallel to and connected with the main waiting room by a wide thoroughfare is the concourse,a covered assembling place over 200 feet wide, extending the entire width of the Station, and under Thirty-first and Thirty-third streets. It is directly over the tracks on which the trains arrive and depart. The concourse is the vestibule to the tracks; stairs descend from it to each of the train platforms. All of this area is open to the tracks, forming a court-yard 340 feet wide by 210 feet broad, roofed by a lofty dome of iron and glass. In this dome the architects have attempted to give a simple architectural expression to structural steel without the use of ornament. This has been done considerably abroad, notably in the railway stations at Frankfort and Dresden, Germany, but it has never before been attempted in this country. The design, which involves intersecting arched vaults, is, from a structural view, distinctly more complicated than the European examples cited.

In addition to the entrances to the concourse from the waiting room, and from Eighth Avenue, there are direct approaches from the two side streets. Midway in the block between Seventh and Eighth Avenues and opposite the entrance to the Station on Thirty-third Street, is a wide private street, which affords direct communication with Thirty-fourth Street, an important crosstown thoroughfare. Leading up from the exit concourse of the Station to this private street is a moving stairway.



PENNSYLVANIA STATION.

Concourse, showing detail of one of the Exits to Thirty-third Street

Underlying the main concourse and located between it and the tracks is the exit concourse, 60 feet wide, which will be used for egress purposes only. This exit concourse is eighteen feet above the train platforms and is connected with them by two stairways and one elevator from each platform. From the exit concourse ample staircases and inclines lead directly to the two side streets, Thirty-fourth Street and Eighth Avenue. In addition, the Company has arranged for direct connection with subways in Seventh and Eighth Avenues, when these lines are built.

For the first time in this country, a station has been planned in such a way as to provide for the complete separation, above the train platform level, of the incoming and outgoing traffic; this, to a great extent, should avoid much confusion. The Station is so located and designed that the traffic may enter or leave the building on any of the four adjoining streets and avenues, and in this manner congestion is avoided.

The northern side of the Station extending along Thirty-third Street is assigned to the Long Island Railroad. Into this part of the Station trains will run from all points on Long Island by way of the East River tunnels. Separate ticket offices, entrances and exits are provided, so that this suburban traffic can be handled independently of the rest of the Station.

The third level for the passenger is the train platform, about thirty-six feet below the surface of the street. This Station is the first one in America in which a trunk line has adopted the raised platform construction, similar to that used in England. The confusion, delay and awkwardness of people entering and leaving railway carriages by the steep steps now in use will be entirely done away with, and the rapid handling of large crowds will be very materially facilitated.

A description of this vast improvement is incomplete without figures showing just how enormous it really is. The area of the Station and yard is twenty-eight acres, and in this there are sixteen miles of track. The storage tracks alone will hold 386 cars. The length of the twenty-one standing tracks at the Station is 21,500 feet. There are eleven passenger platforms, with twenty-five baggage and express elevators. The highest point of the tracks in the Station is nine feet below sea level.

The station building is 784 feet long and 430 feet wide. The average height above the street is 69 feet, while the maximum is 153 feet. To light the building it will take about 500 electric arcs and 20,000 incandescents.

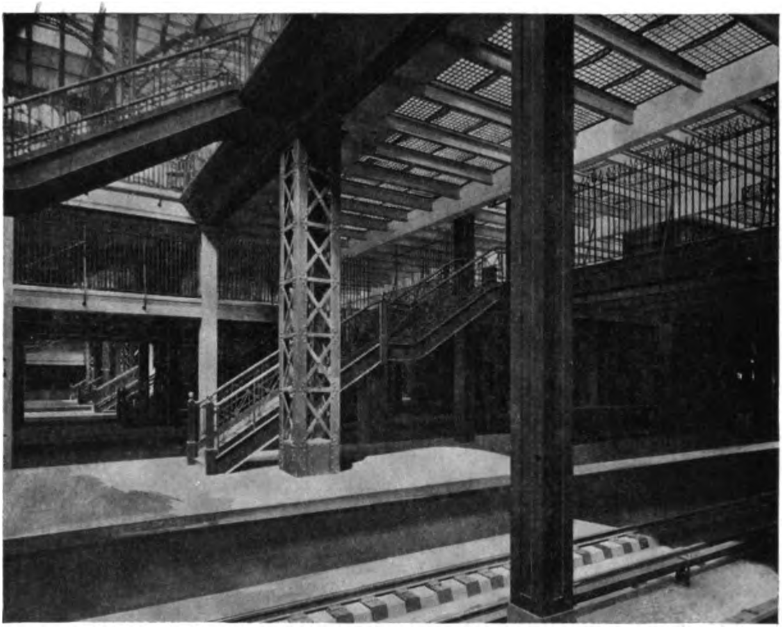
More than 150,000 cubic yards of concrete were required for the retaining walls, foundations, street bridging and the substructure. There are 650 columns supporting the station building and the greatest weight on any one of these is 1658 tons.

The rver tunnels leading to the Station are, all told, 6.8 miles long, and the land tunnels have the same length. From the Bergen Hill portal in New Jersey to the Long Island entrance of the tunnels it is 5.3 miles. It is 8.6 miles from Harrison, New Jersey, in the Station in New York, while from the latter point to Jamaica the distance is 11.85 miles.

The maximum capacity in trains per hour of all of the Pennsylvania tunnels is 144, and the proposed initial daily service will consist of about 600 Long Island Railroad trains and 400 Pennsylvania trains.

The stone work of the Station, covering some eight acres of ground, was completed on July 31, 1909. To enclose this vast area has necessitated the building of exterior walls aggregating 2458 feet—nearly half a mile—in length, and has required 490,000 cubic feet of pink granite. In addition, there have been utilized inside the concource 60,000 cubic feet of stone. A total of 550,000 cubic feet of "Milford pink granite" have thus been utilized in the construction and ornamentation of this building. It took 1140 freight cars to transport these 47,000 tons of stone from Milford, Mass.

In addition to the granite, the construction of this building has called for the use of 27,000 tons of steel. There have also been set in place some 15,000,000 bricks, weighing a total of 48,000 tons. The first stone of the masonry work on the building was laid June 15, 1908; the entire masonry was thus completed in approximately thirteen months after the work was begun.



PENNSYLVANIA STATION.

Track Level, showing Stairways and Elevators leading to Exit Concourse.

To give a condensed history of the construction of the New York Improvement of the Pennsylvania Railroad, and to record the names of those who have had most to do with the work, the Company, through the Board of Directors, has placed two tablets on the sides of the main entrance to the Station on Seventh Avenue. The tablet on the right as one enters the Station bears the following inscription:

> "This tablet is erected by the Board of Directors of the Pennsylvania Railroad Company to commemorate

the extension of its Railroad System into New York City by the completion and opening on the Eighth day of September, A. D. 1910, of the tunnels and Station, and to record the names of the Directors and Officers who shared the responsibility of authorizing and constructing the undertaking.

The tunnels and Station were planned and constructed under the executive direction and supervision of Alexander Johnston Cassatt, President, and Samuel Rea, Vice-President, of the Companies, incorporated in 1902 in the States of New York and New Jersey, and later merged, constituting the Pennsylvania Tunnel and Terminal Railroad Company.

General Counsel, George V. Massey.

BOARD OF ENGINEERS AND CHIEF ENGINEERS.

Chairman, General Charles W. Raymond.
Gustav Lindenthal, resigned December 15, 1903.
Chief Engineer, North River Division, Charles M. Jacobs.
Chief Engineer, East River Division, Alfred Noble.
Chief Engineer, Electric Traction and Station Construction, George Gibbs.
Chief Engineer, Meadows Division, William H. Brown. retired March 1, 1906, succeeded as Chief Engineer by Alexander C. Shand.
Architects, New York Station, McKim, Mead & White.

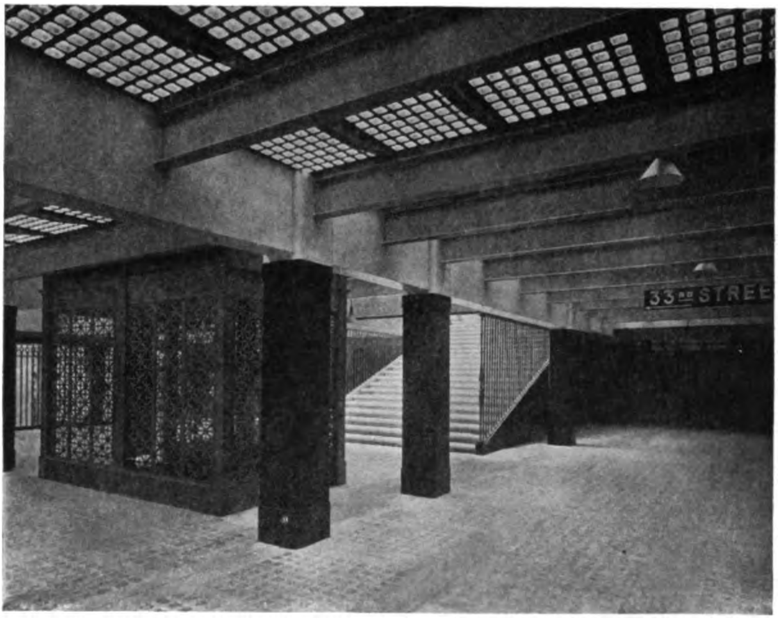
BOARD OF DIRECTORS OF THE PENNSYLVANIA RAILROAD COMPANY

Alexander Johnston Cassatt, President, died December 28, 1906.
Sutherland M. Prevost, Vice-President, died September 30, 1905.
William L. Elkins, died November 7, 1903.
Amos R. Little, died December 16, 1906.
Alexander M. Fox, died October 6, 1907.
John P. Green, Vice-President, retired March 24, 1909.
N. Parker Shortridge,
Clemena A. Griscom,
William H. Barnes,
George Wood,
C. Stuart Patterson,
Effingham B. Morris,
Thomas DeWitt Cuyler,
Lincoln Godfrey,
Rudolph Ellis,
Henry C. Frick,
Charles E. Ingersoll,
Percival Roberts, Jr.
W. W. Atterbury, Fifth Vice-President.
Henry Tatnall, Fourth Vice-President.
John B. Thayer, Third Vice-President.
Samuel Rea, Second Vice-President.
Charles E. Pugh, First Vice-President.
James McCrea, President.

Inscribed on the other tablet is the following:

PENNSYLVANIA TUNNEL AND TERMINAL RAILROAD
COMPANY

The franchise from the City of New York authorizing the construction, maintenance and operation of the Tunnel Extension and Station of The Pennsylvania Railroad System was granted October 9, 1902, by the



PENNSYLVANIA STATION.

Exit Concourse, showing one of the Exit Elevators, and Stairway leading to Thirty-third Street.

BOARD OF RAPID TRANSIT RAILROAD COMMISSIONERS

Alexander E. Orr, Chairman.
John Claflin, Edward M. Grout,
Morris K. Jesup, Woodbury Langdon,
Charles Stewart Smith, John H. Starin,
Mayor, Seth Low.

The construction of the Tunnel Extension was begun June 10, 1903. The two tunnels under the North River and the four tunnels under the East River were built by shields driven from each side of the respective rivers, and union was completed by the junction of the last tube on the following dates:

North River Tunnels, October 9, 1906.
East River Tunnels, March 18, 1908.

These were the first tunnels for standard railroad trains constructed under these rivers.

The construction of the New York Station building was begun May 1, 1904, and trains were first operated from it on regular schedule September 8, 1910.

The principal contractors were:

North River Tunnels
O'Rourke Engineering Construction Company.

East River Tunnels
S. Pearson & Son, Inc.

Crosstown Tunnels—East River to New York Station
United Engineering and Contracting Company.

New York Station
Engineers, Steel Structure and Machinery: Westinghouse, Church, Kerr & Co.
Excavation: New York Contracting Company.
Erection: George A. Fuller Company.

Bergen Hill Tunnels
William Bradley.

Meadows Division
McMullen & McDermott.—H. S. Kerbaugh.
Henry Steers, Inc.

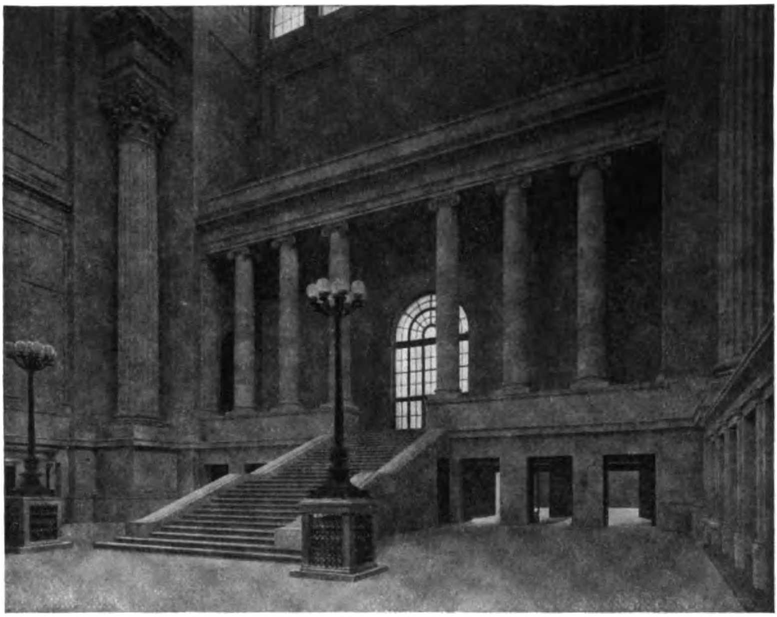
Sunnyside Yard and Approaches
Degnon Realty and Terminal Improvement Company.
Naughton Company and Arthur McMullen.

Erected by the Board of Directors of The Pennsylvania Railroad Company on the Eighth day of September, 1910."

It is impossible to insert in these tablets the names of all those discharging responsible duties on the Tunnel Extension, but the Management fully appreciates and recognizes the ability and fidelity which secured the completion of the work, and especially that displayed by the Assistant Chief Engineers and their staffs engaged in the hazardous as well as unique task of constructing the tunnels under North and East Rivers. Special mention, is, therefore, made of James Forgie and Charles L. Harrison, the Assistant Chief Engineers, respectively, of the North and East River Tunnels; and also E. R. Hill, Assistant to Chief Engineer of Electric Traction and Station Construction, and E. B. Temple, Assistant Chief Engineer, Meadows Division.

This great work must, however, be regarded as representing the united effort and experience of the Pennsylvania Railroad Organization, and while it would be impracticable to make a complete list of all Officers and employes of the entire system who assisted, it is desirable to mention the following members of the several Committees and others, who co-operated with and assisted the Executives and the Board of Tunnel Engineers in the formulation of designs and plans for the operating, terminal, track, yard, mechanical, electrical and signaling requirements, and in the solution of the important problems necessitated by the scope of the improvement project:

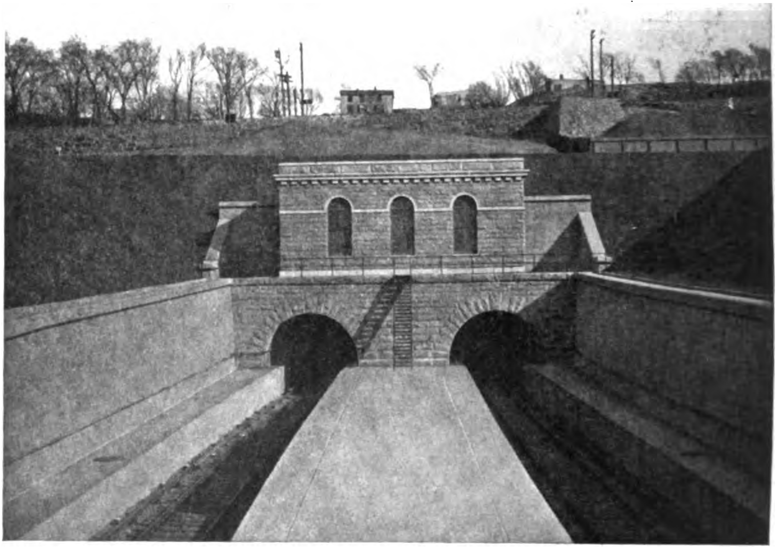
Jos. T. Richards, Chief Engineer Maintenance of Way, as Chairman of various Committees on operation, track and yard work requisites; Theo. N. Ely, Chief of Motive Power, as Chairman of the Mechanical and Electrical Advisory Committee; W. Heyward Myers, General Manager; F. L. Sheppard, General Superintendent, New Jersey Division; Benj. W. Carskaddon, Real Estate Agent; J. R. Wood, Passenger Traffic Manager; D. S. Newhall, Purchasing Agent; R. Trimble, Chief Engineer Maintenance of Way, Northwest System, Lines West; W. C. Cushing, Chief Engineer Maintenance of Way, Southwest System, Lines West; A. W. Gibbs, General Superintendent of Motive Power; D. F. Crawford, General Superintendent of Motive Power, Lines West; Chas. M. Sheaffer, Superintendent Passenger Transportation; R. M. Patterson, Superintendent Freight Transportation; L. R. Zollinger, Engineer Maintenance of Way; Axel S. Vogt, Mechanical Engineer; B. F. Wood, Assistant Engineer, Altoona, Pa.; H. R. Leonard, Engineer of Bridges; A.



PENNSYLVANIA STATION.

Driveway on Thirty-first Street side, looking from Entrance to Concourse toward Seventh Avenue. The Overhead Bridge leads directly into the Main Waiting Room.

M. Parker, Principal Assistant Engineer, New Jersey Division; R. L. O'Donnel, General Superintendent, B. & A. V. Division; D. H. Lovell, Superintendent, W. J. & S. R. R. Co.; F. P. Abercrombie, as Superintendent of New York Division; D. C. Stewart, as Superintendent of Telegraph, and J. B. Fisher, who succeeded him in that position; A. H. Rudd, Signal Engineer; L. H. Baker, Principal Assistant Engineer; U. R. R. of N. J. Division and, later as Engineer of Construction, Sunnyside Yard; H. C. Booze, Principal Assistant Engineer of Branch Lines; Ralph Peters, President and General Manager and J. A. McCrea, General Superintendent of Long Island R. R. Co.; C. S. Krick, Superintendent and A. J. County, Assistant to President, Pennsylvania Tunnel and Terminal Railroad Company.



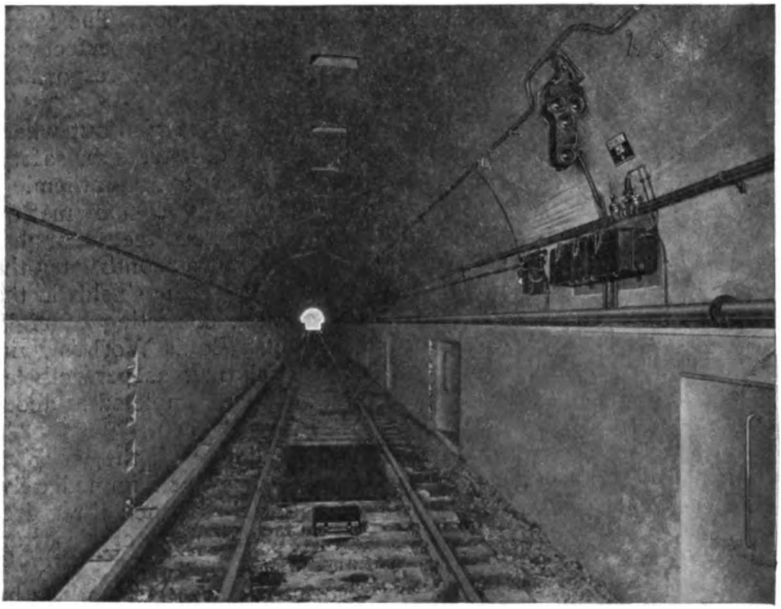
PENNSYLVANIA TUNNELS.

Hackensack Portals of Bergen Hill Tunnel in New Jersey.

The New York Tunnel Extension of the Pennsylvania Railroad running east and west from the New York Station begins at Harrison, New Jersey, a short distance east of Newark. Here is located a transfer yard for the huge electric locomotives used in the tunnels. At this point through passenger trains from Southern and Western points will change from steam to electric power, and whose destination is in the downtown district of New York, may alight here and walk across the transfer platform to an electric train which will run into the Church and Cortlandt Street Station of the Hudson & Manhattan Railroad. This downtown rapid transit electric train starts from a new station on Military Park.

in Newark, thence by a new bridge over the Passaic River at Centre Street, to Harrison, where passengers may transfer to trains for the Pennsylvania Station uptown, or continue to Jersey City and lower New York.

The through trains for New York leave Harrison on rails crossing over the old Pennsylvania tracks on a steel and concrete bridge. A double-track elevated line on embankments and bridges extends across the Hackensack Meadows to Bergen Hill, that high eminence which is a continuation of the rocky cliffs extending along the Hudson River. In the western slope of this hill are found the entrances to the tunnels which lead under the North River, into the Station in New York.



PENNSYLVANIA TUNNELS.

Interior, showing Signal Apparatus.

The construction of the Pennsylvania Railroad tunnels under the North and East Rivers into New York and New Jersey, attaining a maximum depth of 97 feet below mean high water, and built for a heavy and high-speed traffic of great volume, was an undertaking without precedent.

The tunnels or tubes themselves consist of a series of iron rings, and the installation of every ring meant an advance of two and a half feet. Eleven segments and a key piece at the top complete the circumference, and an entire ring weighs about fifteen tons. The cast-iron plates, or sections of the ring, have flanges at right angles to the surface, and it is through these that the successive rings are held together with bolts. The record progress in one day of eight hours was five of these rings, or twelve and one-half feet. Hydraulic rams, placed against the flanges every few inches around the tube were used to push forward the huge shields with which the tunnels were bored. This type of shield weighed 194 tons. It had nine doors in it, and through these came the rock, or sand, or silt, or whatever material the tube penetrated.

To insure that the east and west-bound shields would meet exactly, the engineers calculated the difficulties closely, and a really remarkable system of reports was in effect from the first day work was started. Every morning they knew the progress made in the tunnels the day before, to the very inch, and the amount of rock and soil excavated, to the cubic foot. The Pennsylvania Railroad Officers and the engineers hold this perfect system and the thoroughness of each day's work chiefly responsible for the accuracy of the meeting of the tubes.

Engineers say, too, that no project was ever carried out where emphasis was placed entirely upon the results—strength, safety, permanency—rather than upon the money it cost to attain them.

The shields in the north tube under the Hudson River met on September 17, 1906. Each had traveled some 3000 feet through a river bed, yet the meeting was perfect. About a month later the shields in the south tube met in the same way. The shields in the south tube were united by a tunnel section, consisting of eight rings, that had been on exhibition at the St. Louis World's Fair. The shields in the four East River tunnels met as perfectly as those in the Hudson River tubes, and all were completed at about the same time.

When the tubes were through from end to end, the work of putting in the 22-inch concrete lining was started immediately. On each side of the tunnel there is a so-called bench three feet wide, which serves as a walk, and under which are carried conduits for telegraph, telephone, signal and power wires.

In the construction of the tunnels, nothing was left undone by the Railroad Company to protect the lives and health of the workmen.

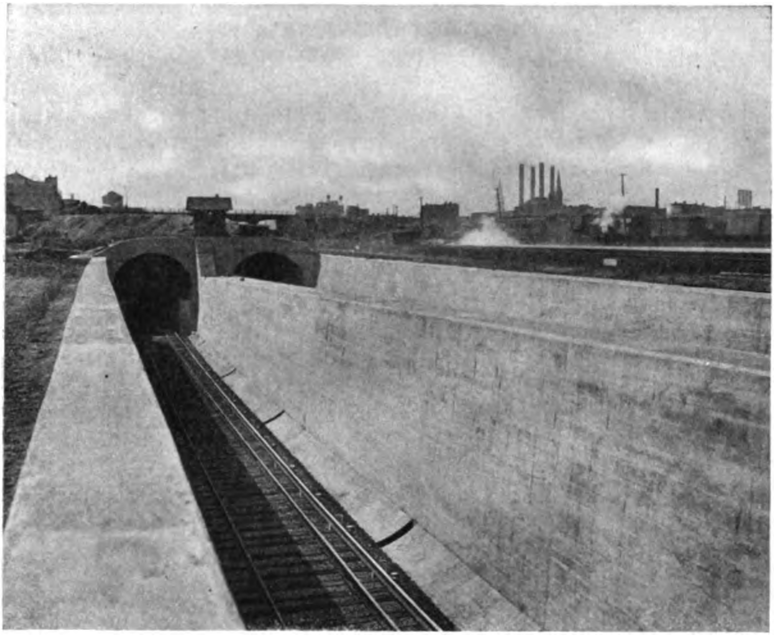
No engineering problem connected with the entire New York Tunnel Extension received more attention than did the many precautions to protect the hundreds of men who, day and night, weekdays, Sundays and holidays, bored the under-river tunnels. Down under many fathoms of mud, gravel and rock the iron tubes which land passengers from the East and West into the heart of New York City were pushed steadily forward with no more waste of time than it took to change the "shifts."

Under-water work has a fearsome sound—to those who have never seen it going on. Talk to men who have been engaged in it for years and you get another idea. There are plenty who can speak with authority, for the world was searched for men of the ripest experience to build the Pennsylvania tunnels. On the crosstown shafts, sixty Austrians, who received their training in the Simplon tunnel, were employed. There were engineers and foremen here who had tunneled in Egypt, South Africa, England

and America, and who now are doubtless looking for other subterranean regions to conquer.

To make it as safe under the bed of the river as it is on the land's surface was the aim of the Pennsylvania tunnel builders.

The work was performed so thoroughly and with such skill that the engineers, their assistants, and the laborers have left a permanent monument to the mastery of science over the greatest physical barriers of nature. As a result of the nine years of thought and arduous labor, which made possible the Pennsylvania tunnels and Station, the traveler can now be carried straight into the heart of New York City on tracks encased in tubes of the most substantial construction—tubes which from New Jersey run without a curve to the Manhattan side of the Hudson River. Tubes equally free from curves run from the Station to the East River, under which they shoot, almost in a straight line, to Long Island.



PENNSYLVANIA TUNNELS.

Two of the Long Island Portals.

When the two tracks emerge from the tubes under the Hudson and reach the entrance to the Station yard at Tenth Avenue they begin to spread out. From this point and extending into the Station, the number grows from two to twenty-one.

The number of tracks leading out of the Station yard to the east gradually decreases from twenty-one to a total of four for the main line. These pass under the city and East River to the Sunnyside Yard on Long Island, the terminus of the tunnel extension, and the point of connection with the Long Island Railroad.

From the Station the Manhattan crosstown twin tunnels, containing four tracks in all, traverse a section of New York City second in importance only to the financial district, and one that includes the larger hotels, retail shops and theaters, and many residences. These tunnels end at the river shaft, situated in the block between Thirty-third and Thirty-fourth Streets east of First Avenue.

Sunnyside Yard, on Long Island, is to the New York Improvement what the West Philadelphia passenger yard is to the Philadelphia Terminal, or the Jersey City Yard to the Jersey City Station. The new yard has many unique features, however, such as the provision for running all trains around a loop—doing away with the use of turntables—pulling them into the coach-cleaning yard at one end and departing from the other end, thus turning the entire train and avoiding the necessity for switching baggage cars and sleeping cars to opposite ends of the trains and the turning of combination cars separately. The arrangement of tracks on different levels makes provision for cross-over movements without grade crossings and eliminates interference with high-speed traffic.

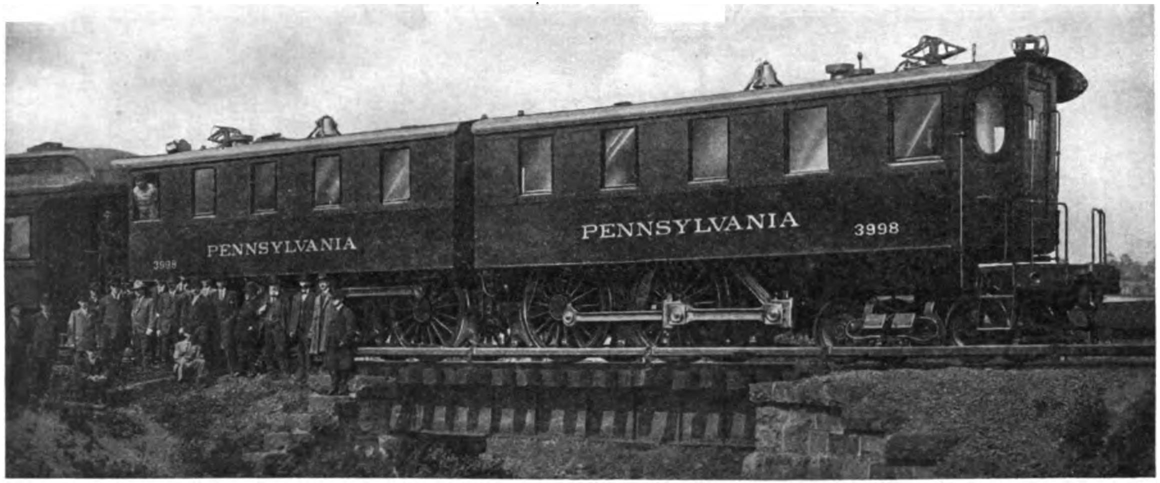
Sunnyside Yard is 5500 feet long with a maximum width of 1550 feet, embracing some 173 acres of land. It contains 53 miles of tracks which have a capacity of 1387 cars. There is additional space for extending the trackage of the yard to provide more car standing-room in the future.

From Sunnyside Yard there are tracks leading to the New York Connecting Railroad, which, when constructed, will form a junction with the New York, New Haven & Hartford Railroad at Port Morris, New York. The Connection Railroad will cross East River by the "Hell Gate" Bridge over Ward's and Randall's Islands.

In connection with its improvements in and around New York City, the Pennsylvania Railroad Company has constructed at Greenville, N. J., an extensive freight transfer yard. It is the most completely equipped yard for rapid and economic handling of freight. From Greenville cars are transported by floats and delivered to the great piers of New York City. Freight destined to Brooklyn or to other points on Long Island is floated across the bay from Greenville to the opposite shore at Bay Ridge, Long Island. Freight for New England and Eastern points is floated up the East River to the New York, New Haven & Hartford Railroad's Port Morris Station. Later, when the New York Connecting Railroad is constructed, freight will be floated to Bay Ridge and run over Long Island tracks to the Connecting Railroad, and thence to the mainland, where connection will be made with the New York, New Haven & Hartford System for Boston and New England points.

One of the most important features of the Pennsylvania Railroad's New York Tunnel Extension is its relation to the Long Island Railroad—a subsidiary line of the Pennsylvania.

In addition to the many millions the Pennsylvania Railroad has



ELECTRIC LOCOMOTIVE.

Type of Locomotive to be used in Pennsylvania Tunnels.

spent for the four tunnels under the East River, and the vast Station and terminal in Manhattan by which all Long Island will benefit, the Long Island Railroad is increasing its own facilities in all directions to take care of the present large traffic and the larger traffic which will come with the use of the tunnels into the Pennsylvania Station in New York. This will place all parts of Long Island and its many seaside resorts within easy reach of New York City.

Tomorrow, for in the construction of vast railroad improvements years count as but days, the New York Connecting Railroad, crossing the East River on a four-track arch bridge, will be completed, and there will be established the first all-rail service between New England and the West and South by way of New York City.

The skill and experience that has evolved the tunnels and Station will not excel that of the Officers and Employees of the Transportation and Traffic Departments of the Company, to whom the tunnel extension is now committed for successful operation. The traveler may rest assured that nothing will be left undone to insure his safety, comfort and convenience while on the Pennsylvania System.

THE WATER SUPPLY OF LIVERPOOL, ENGLAND

BY KENNETH C. GRANT*, Member.

Introductory

The City of Liverpool, one of the greatest seaports of the world, with a population of about 900,000, is located on the west coast of England, on the estuary of the Mersey River. The main purpose of this article is to describe the most interesting part of the present water supply, that from the Vyrnwy reservoir, in North Wales. Brief mention will be made, however, of the other sources of supply, and of the conditions prior to the construction of the Vrynwy reservoir and aqueduct.

Early Sources of Supply.

Up to 1847, the water supply of Liverpool was furnished by private companies. For the 25 years prior to the above date there were two rival concerns, which at first disputed but eventually divided the territory. Both obtained their water from driven wells in the red sandstone. The quality of this water was excellent but the supply inadequate. As population and shipping, and the demands of fire protection increased, this shortage became a very serious matter, and was only partly alleviated by boring new wells and deepening old borings from time to time. The water was turned on only two or three times a week, and then for only two or three hours.

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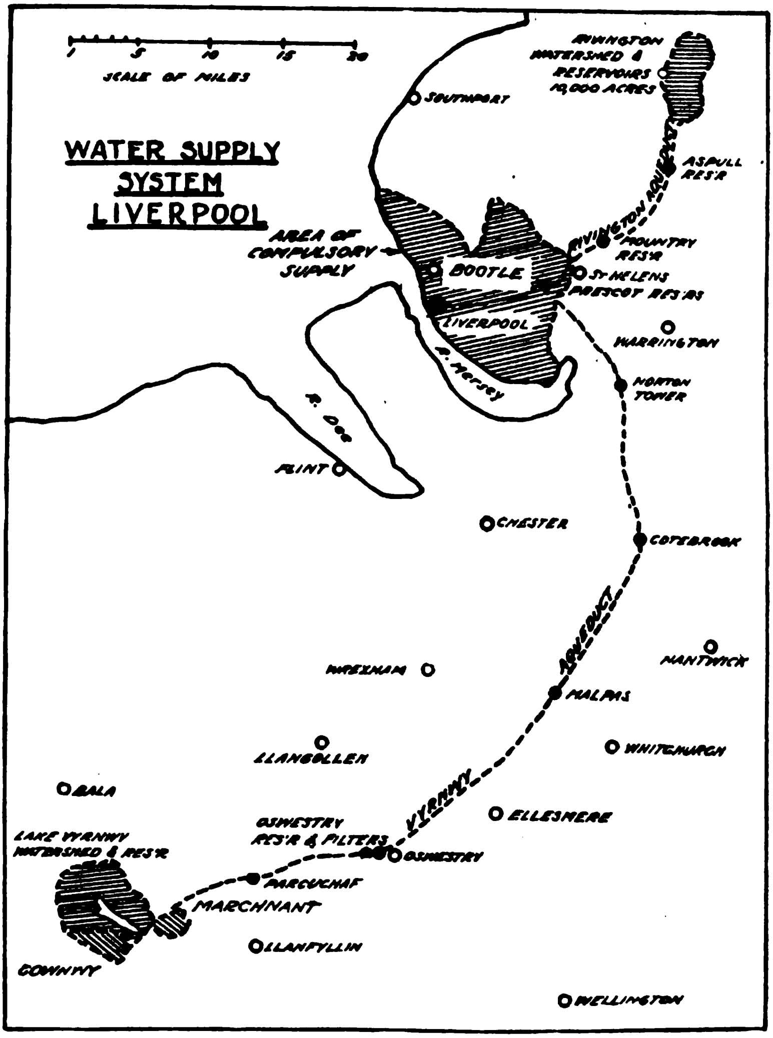
*Prin. Asst. Engineer, Flood Commission of Pittsburgh.

In 1847 the two companies were acquired by the Corporation of Liverpool, and considerable addition to the well supply was made. At the time the companies were taken over by the city, the daily consumption was only 8 to 11 gallons per capita, including water for domestic, industrial and shipping purposes. As a result of this inadequate supply and low consumption, very unsanitary conditions prevailed.



The Rivington Supply

In 1852, the Rivington Reservoirs were begun and water therefrom was first delivered to the city in 1857. The use of the wells was continued and their water was mixed with the Rivington water, which was somewhat turbid at first, but improved in quality as the filters at Rivington were gotten into good working order.

The Rivington Reservoirs

The Rivington Reservoirs are located about 24 miles to the northeast of Liverpool, and at elevations varying from 558 to 615 feet above sea level. The drainage area tributary to the reservoirs comprises about 10,000 acres of thinly-inhabited hill and moorland. There are 8 reservoirs, all formed by earthen dams with puddle core walls. The capacities vary from 57,960,000 gallons to 2,209,200,000 gallons, and the total capacity of the group is 4,926,120,000 gallons. The dams are of considerable height, varying from 39 to 103 feet and have a 3 to 1 paved slope on the inner or water side, and a 2 to 1 sodded slope on the outer side. The highest dam is notable in that the puddle trench was carried down to a depth of 167 feet below the natural surface to reach rock foundation, the total height from the bottom of core-wall foundation to top of dam thus being 257 feet.

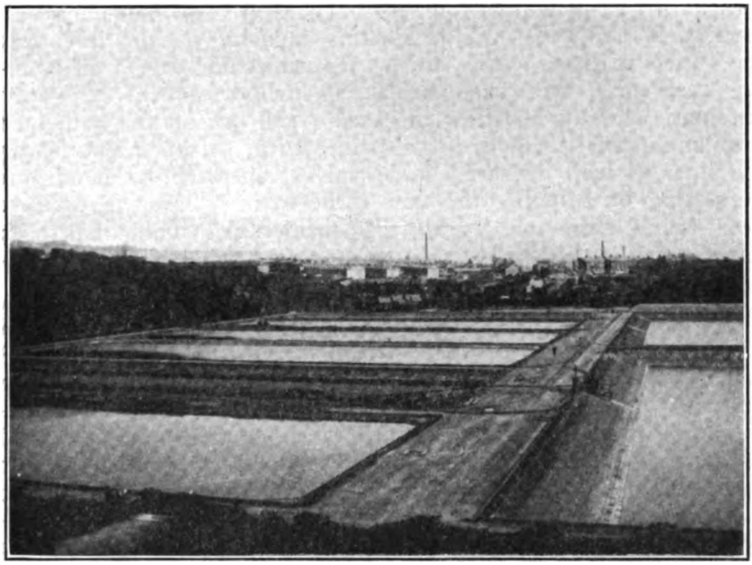
Very thorough sanitary precautions are taken on the drainage area tributary to the reservoirs. All dwellings and farm buildings have their sewage treated. Those in groups, or not too widely separated, are connected to a main sewer, which leads to a disposal system. Remote farmhouses have septic tanks in which house and farmyard wastes are collected. A drain from the top of these tanks is carried along under the sod fifty yards or more, and it is found that, in this distance, the ground absorbs the effluent without harmful effects. About seventy farmhouses, where this method could not be satisfactorily carried out, were razed. The area is policed daily to insure the carrying out of the rigid sanitary regulations.

The Rivington Filtration Works

The water from all the reservoirs passes into the lowest of the group and thence into the filters, which are of the slow-sand type, and interesting as an example of the kind of filter bed built 50 years ago, the last beds having been built in 1867. There are 8 beds, with a combined area of 5.82 acres. Like the other early filter beds in England, these are built with sloping sides. The chief peculiarity, however, is in the great thickness and the arrangement of the filtering medium. The beds have the usual drains in the bottom for carrying off the filtered water. These drains are covered with flag stones, on top of which are placed large stones on edge, arranged much the same as a Telford base for a road. Coarse gravel on top of these stones brings the thickness up to 6 feet, and 2 feet more of finer gravel makes a depth of 8 feet. A layer of sand 2 feet 6 inches thick completes the bed. The average rate of filtration in these beds is about 8¼ cubic feet per square foot per day.

When the loss of head in the filters becomes too great, 2 to 3 feet, the water is drained off and the film of scum on top of the sand is allowed to partly dry until about like blotting paper.

Clear water is then put in from below, raising this film from the sand. When the water from above is admitted in the usual manner, the filter starts service again with a low filtering head. This operation is repeated until the filtering head increases too rapidly after renewing operations, when the water is drained off, about an inch of sand, including the layer or mat of scum, is removed, and the filter again put into service. This process is repeated until the sand remaining in the filter bed is reduced to a thickness of about 12 inches. All the sand is then taken out and replaced with washed sand to a depth of 18 inches, on top of which is spread the 12 inches taken from the bottom.



View of Filter Beds at Rivington.

This method of raising the film of scum has only been in operation during the last few years at Rivington, and is stated to give complete satisfaction with that water and to effect a considerable saving. Formerly, as soon as the loss of head in the filters became too great, the top inch of sand was immediately removed. This had to be done about every 2 months, while with the present method the sand is scraped off only about every 6 months. On this basis, it is expected that the sand will have to be renewed only every 9 years, instead of every 3 years, as formerly.

The sand is washed by machinery. The process consists in carrying the sand by conveyor from the pile to an agitated screen, which removes the gravel, and drops the sand into two tanks beneath. Jets of water spray into these tanks from below, and two shafts carrying propellor blades turn in opposite directions, churning up the sand in the path of the water jets. When the sand is sufficiently washed, the shafts are revolved in the same direction, and act as a screw conveyor, carrying the sand out of the tanks into bins, from which it is taken by a conveyor to small cars for delivery to the filter beds. The cost of washing the sand in this manner is about 16 cents per cubic yard.

The Rivington Aqueduct

The water from the filter beds passes to a filtered water reservoir, from which it enters the aqueduct, 24¼ miles long, leading to the distributing reservoirs at Liverpool. With the exception of a brick-lined tunnel, 4,428 feet long, this aqueduct is constructed of 44-inch cast-iron pipe. There are two balancing reservoirs of about 9½ million gallons capacity on the line. At the outlets of these two balancing reservoirs and of the distributing reservoirs, there are self-acting cylindrical valves, which automatically stop the flow in case of a break on the aqueduct. Similar automatic valves are also located at several points along the line, as well as screw slide valves, operated by hand, for regulating or stopping the flow if desired. These valves have been found extremely useful, as considerable trouble has been experienced on account of the settlement of portions of the aqueduct, due to subsidence of the ground over coal workings.

The Vyrnwy Supply

The growing population and rate of consumption kept calling for more water, and in spite of the largely increased supply furnished by the Rivington reservoirs, the time came when the need of an additional source of supply became imperative. Reports were made on a number of projects, and finally, in 1879, the Vyrnwy scheme, in North Wales, was adopted by the City Council. A water supply from the mountains of North Wales, which are visible from Liverpool, had long been thought of, as there is a heavy rainfall and a sparse population.

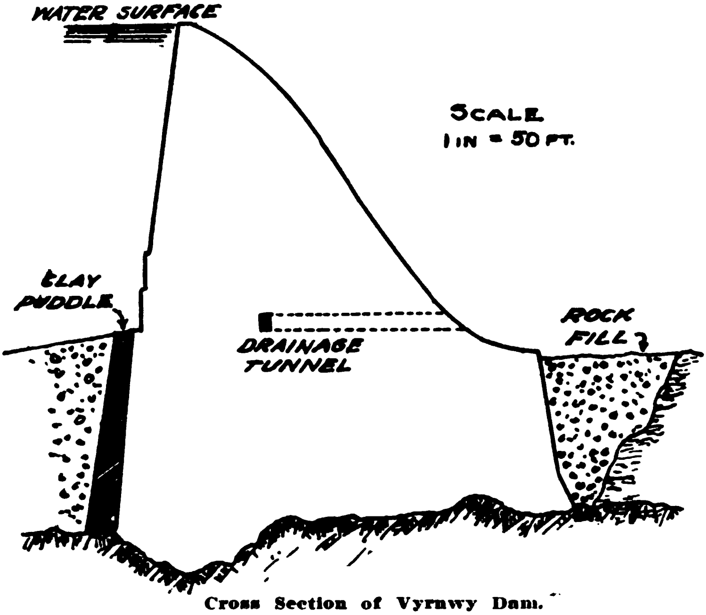
The Vyrnwy is a tributary of the Severn, formed by a number of smaller streams in an alluvial tract about 780 feet above sea level, surrounded by mountains and hills of about 2,000 feet elevation. The mean annual rainfall on its drainage basin varies from 40 to 105 inches, according to location, and in general averages about 70 inches.

The first studies for the Vyrnwy project were made in 1876-7, and the surveys and plans in the summer of 1879. The work was begun in July, 1881, and completed in July, 1892. It was carried out by the City's engineers without the employment of a contractor, except on the aqueduct. The project, briefly, consists of the construction of a large masonry dam, and of an aqueduct to carry the water from the storage reservoir to filter beds and thence to the distributing reservoirs at Liverpool. It was the first project of this kind in Great Britain for which a high masonry dam was used, and at the time of its completion was the largest artificial reservoir in Europe.

The Vyrnwy Supply

The principal features of the dam are as follows:

Length of crest from rock to rock, ...	1,172 ft.
Maximum height of spillway above natural surface, ...	84 ft.
Maximum depth of foundation below natural surface, ...	60 ft.
Maximum height of spillway above foundation, ...	144 ft.
Maximum thickness at base, ...	127 ft.
Excavation for foundation, ...	220,890 cu yds.
Masonry, ...	260,000 cu. yds.



Cross Section of Vyrnwy Dam.

The following are the main features of the reservoir:

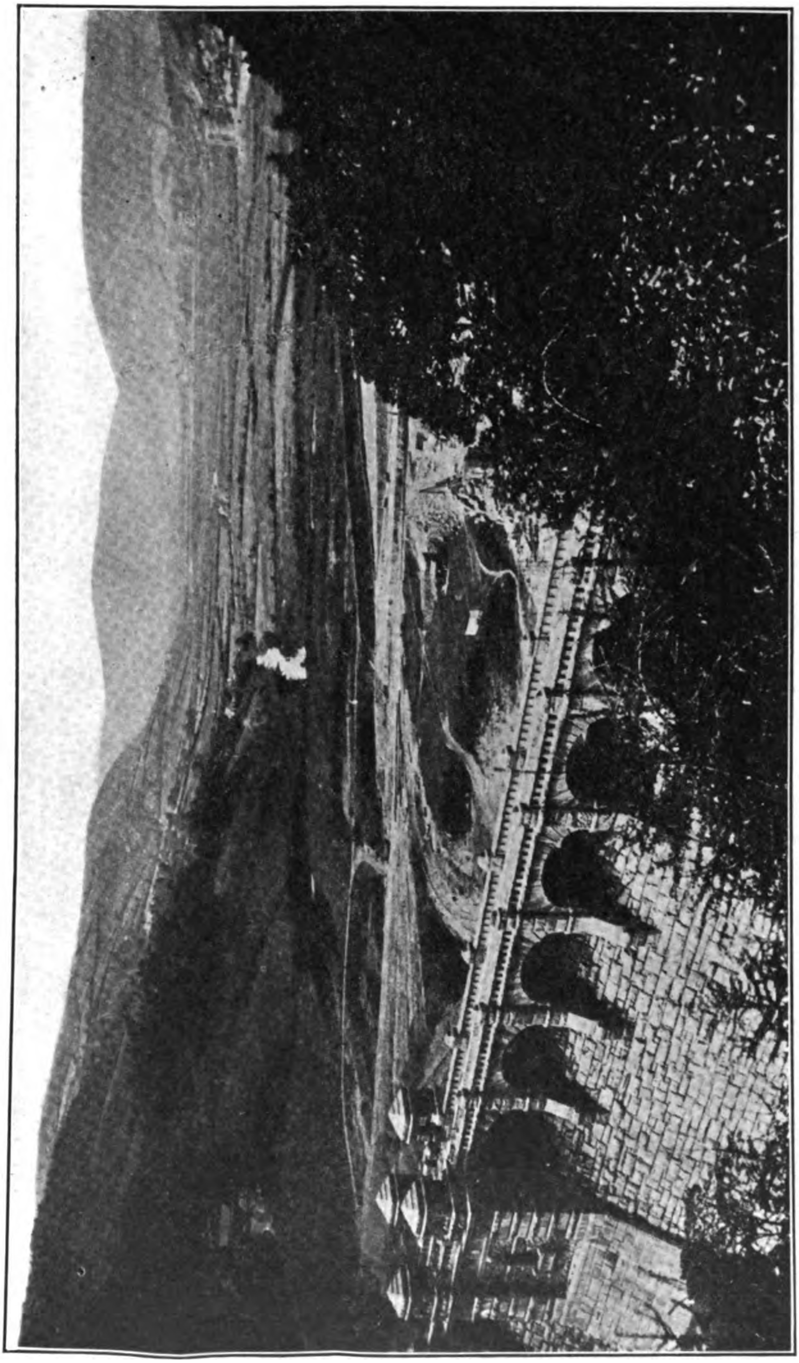
Length, ...	4.75 miles
Area of water surface, ...	1,121 acres
Greatest depth, ...	84 ft.
Capacity, ...	1,946,150,000 cu. ft.
Drainage area above dam, ...	26.25 sq. miles
Additional drainage area obtained by diversion, ...	9.28 sq. miles
Total drainage area controlled, ...	35.53 sq. miles
Cost, ...	$2,972,470
Cost per million cubic feet of storage, ...	$1,527

The land overflowed by the reservoir involved the quaint little village of Llanwyddyn, pronounced approximately "Than-oothin," although no phonetic spelling could suggest the correct pronunciation of the first syllable. The entire village of about 40 houses, with churches and school buildings, was rebuilt below the dam. About 12 miles of road also had to be relocated.

The site chosen was peculiarly favorable for impounding a large body of water. The valley is the site of an old glacial lake, with a ridge or bar of rock crossing the basin below the surface at a narrow part of its southern extremity. This favorable site was chosen for the dam, and numerous borings were made and the rock surface contoured, showing the maximum depth to rock to be from 40 to 45 feet. The upper part of this rock was broken and fissured, the solid, watertight rock being from 6 to 7 feet below the rock surface.

As the dam was 127 feet wide at the widest part of the base, and 1,172 feet long, a large amount of excavation was necessary to get down to the rock described above. The sides of the trench were not timbered, but were sloped back on a 1 to 1 slope. The excavation contained many large boulders, which were mostly removed by manual labor, working night and day. When rock surface was reached, all loose and detached rock, however large, was removed, down to solid, unfissured bed rock, which, at the deepest point, was obtained at about 60 feet below ground surface. Long, steep slopes were benched and all rock surfaces thoroughly washed with hose and scrubbed with wire brushes. No visible springs were encountered in the foundations, but it was thought that after the dam was completed and the reservoir filled, the considerably increased head might open up springs and cause an upward pressure on the dam. To guard against this possibility, drains 6 inches by 9 inches were formed by the masonry along the bases of the principal beds of rock and from these, other drains were led to a longitudinal drainage tunnel, 4 feet 3 inches by 2 feet 6 inches, shown in the cross-section of the dam. From this longitudinal tunnel, a cross tunnel leads to the down-stream face of the dam, and serves as an outlet for the water and for entrance to the main tunnel. Very little water has been gathered by these drains; in fact, for the central length of 642 feet, representing a foundation area of 24,000 square feet, only about 2.4 gallons a minute is discharged.

The rock, a clay slate, was quarried about a mile above the dam and carried to the work on a narrow-gauge railroad, when it was handled by travelling cranes along the upstream side of dam. A small reservoir was built above the quarry and furnished water at about 140 feet of head, which was used for washing the stone. The masonry was laid with exceptional care, all joints and openings being tightly filled and rammed with concrete, mortar and spalls, and the water-tightness of the work testifies to its excellence. Portland cement was used, mixed at first with a glacial sand from the locality, and later, after careful tests, with crushed rock, which gave a mortar in which the irregular stones bedded better than in the glacial sand mortar. The greatest care was taken to protect the work during stops, and to bind new



View of Vyrnwy Reservoir Before Filling.

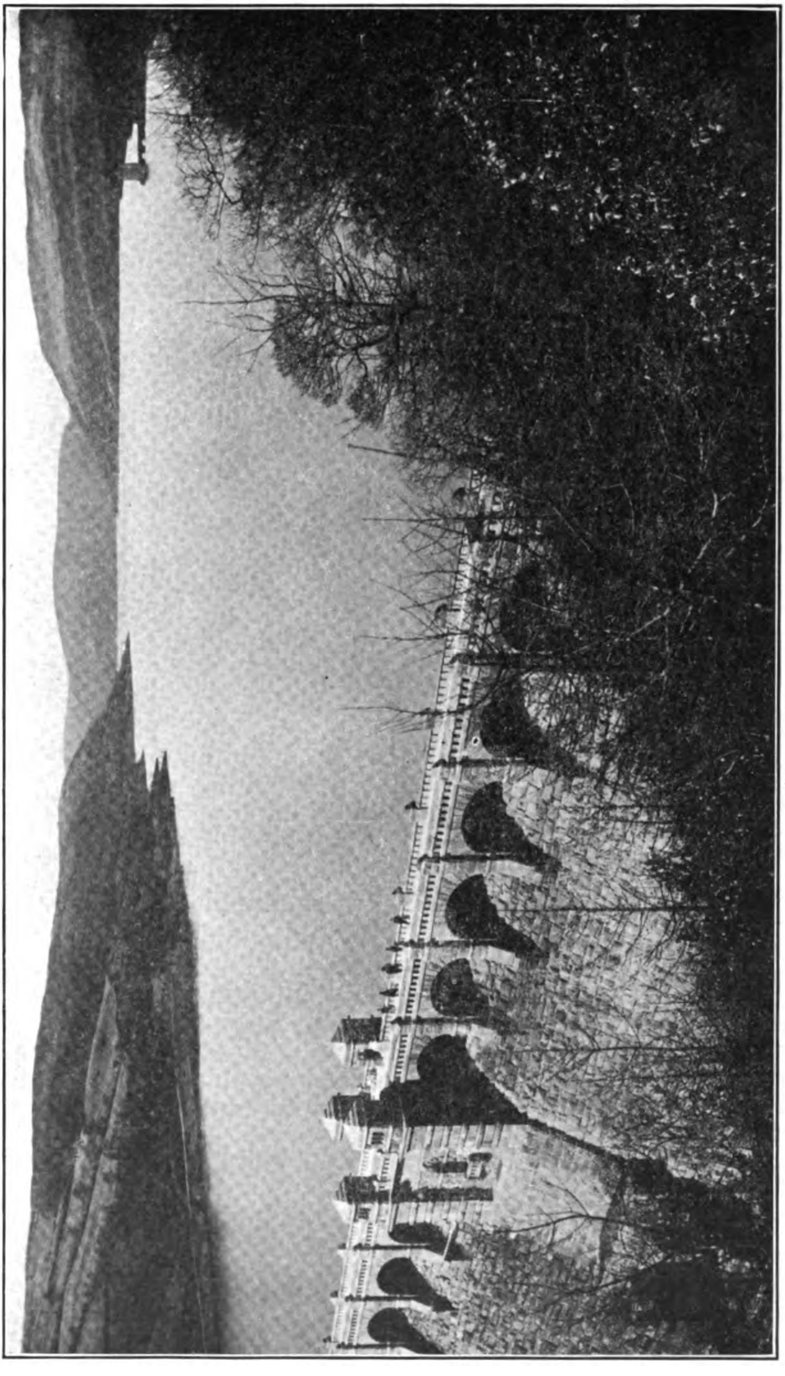
into old work. The joints on the faces of the dam were left open to a depth of from 3 to 6 inches and later caulked to within an inch of pitch line with 1 to 1 Portland cement mortar, mixed very dry and driven in with iron rammers. The faces of the stones were left as from the quarry, in the larger stones, the rough projections extending 18 inches. As an additional precaution for water-tightness, a clay puddle wall was placed against the upstream face of the dam from rock level to ground surface.

Across the top of the dam, a carriage road 20 feet wide is carried on 31 masonry arches of 24 foot span. The portion of the crest under the 19 central arches forms the principal spillway, 456 feet long. A further length of the crest, on each side of the central spillway, 288 feet in all, is arranged as a spillway at a higher level, and provision is made for collecting any possible slight overflow therefrom in masonry channels on the outer face of the dam about at the original side slopes of the valley. At the toe of the dam a massive masonry apron has been built to prevent damage by ice or water.

In the center of the drainage tunnel, described above, a pendulum seismograph was installed after the dam was completed. It is shown by this instrument that the dam is in a constant state of motion, due to temperature stresses.

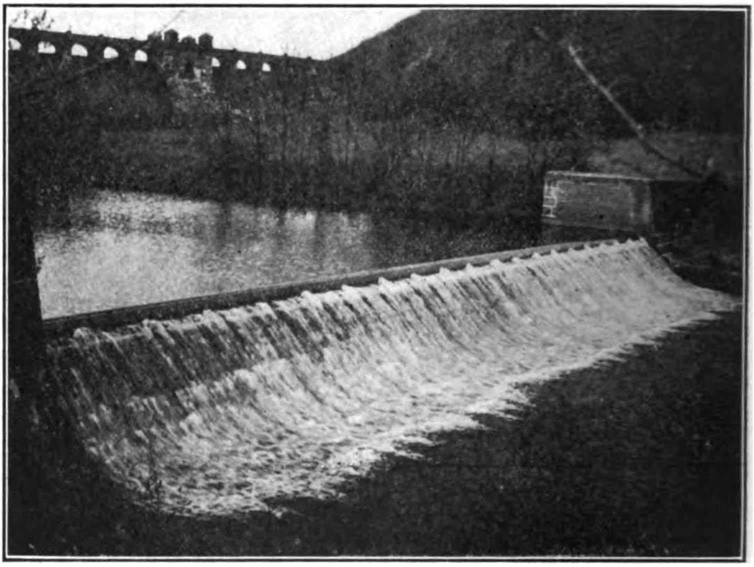
For passing the river water during construction, two circular brick-lined culverts, 15 feet in diameter, were built, one near each end of the dam. These were afterwards closed with a brick bulkhead 19 feet thick, in which discharge pipes, provided with suitable valves, were imbedded. The culvert toward the south, or right-hand, down-stream end of the dam, contains two pipes, 18 inches and 30 inches in diameter, respectively. The 18-inch pipe delivers the so-called "daily compensation" water to the river below, amounting to 12,000,000 gallons daily, or about 18.6 second-feet. The 30-inch pipe is used to discharge the "monthly compensation" water, which amounts to 48,000,000 gallons per day, or about 74.3 second-feet, for 4 successive days in each of the 8 months from March to October, inclusive.

The daily compensation water discharges into a covered concrete basin, and from here passes through 4 vertical plates 1 foot 9 inches apart, by means of holes varying from 1 inch in diameter in the first plate to 1½ inches in the last, and empties into a concrete still-water basin, 8 feet wide, 22 feet long and 3 feet deep. At the downstream end of this basin, the water discharges through a sharp-edged rectangular orifice, 12 inches deep and 37.438 inches wide, in a vertical plate. The sides of the orifice are movable, so that the length can be adjusted. The level of the still water is adjusted to a vertical point projecting 11.904 inches above the upper edge of the notch, the lower edge of which is 12 inches above the bottom of the basin. By means of an ingeniously counterbalanced iron shutter or scoop, the discharge from the orifice can be temporarily diverted into a concrete measuring basin, and the flow for a given time determined by observing the height to which the water rises, thus furnishing



View of Vyrnwy Dam and Reservoir.

a check on the discharge of the orifice, the width of which can be adjusted, if necessary. This volume-measuring device is rarely, if ever, used, except to demonstrate the method of working to visitors. Similar checking arrangements have been noted by the writer at other large dams in England, and they are doubtless merely installed to satisfy the layman as to the accuracy of the apparatus for measuring the compensation water. The monthly compensation water, alluded to above, is measured through 4 orifices, similarly arranged, except that they have no measuring basins. The daily compensation water drives a generator lighting the corporation offices and hotel, and furnishing power for a sawmill and for charging a small electric launch.

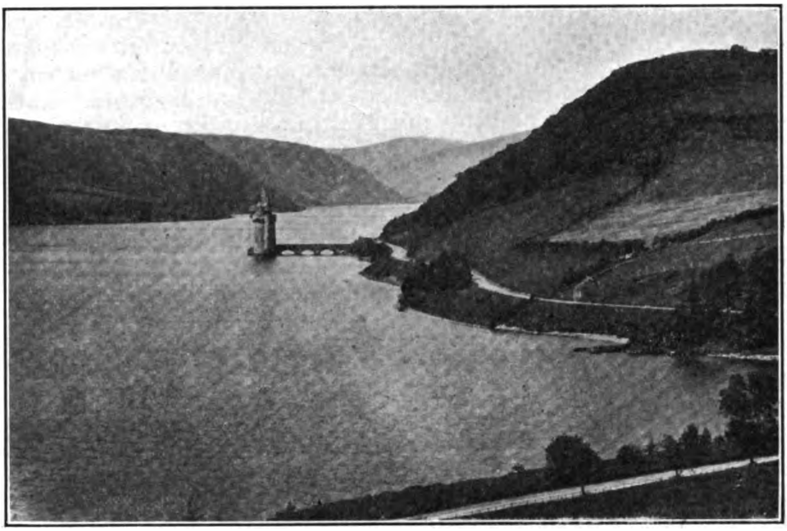


View of Weir below the Vyrnwy Dam.

The northern discharge culvert is similar to the southern, except that there are no devices for measuring outflow, and that there is a single 39-inch pipe imbedded in the bulkhead. In the valve tower above the culvert, there is an automatic gage, which gives a graphical record of the level of the reservoir water surface, by means of a float which moves up and down in a vertical copper tube extending from the highest water level to the bottom of the reservoir.

The regulating effect of the reservoir upon the flow of the Vyrnwy River below the dam is naturally very great. Floods, which frequently did considerable damage, no longer take place; while the dry-weather flow, which formerly almost disappeared, now furnishes a considerable stream of a uniform discharge many times the previous minimum.

A short distance below the dam, a masonry weir has been constructed for measuring the discharge of the river, especially during floods. The crest is 80 feet in length and is formed by a gun-metal lip bolted to an angle-iron on top of the masonry. An automatic float gage, run by clock-work, gives a graphical record of the head on the crest. This gage, except in the gearing, is similar to the one above-mentioned for recording the level of the reservoir water surface. A copper float, 9 inches deep and 15 inches in diameter, is hung in a stilling box by brass picture-cord wire, which operates over a drum. This drum carries a small gear meshing into a large gear, which transfers this reduced motion to the pencil carriage. The recording paper unwinds from a feed drum to the recording drum, one foot in 24 hours, and is arranged to give a month's record. The vertical scale is plotted on the paper as it is received by the recording drum, by pencils mounted on a vertical bar, which makes a jog every six hours as a reference point, thus taking care of any possible shrinkage in the paper and assuring that the zero will always be in the right position. The vertical scale is 0.2 of a foot to 1 foot, and the horizontal scale 0.5 of an inch to 1 hour.



View of Vyrnwy Reservoir and Screening Tower from a Point Near the Dam.

Screening Tower.

The water enters the aqueduct through a screening tower, an imposing and artistic structure on the northern side of the reservoir, about three-quarters of a mile above the dam. The tower is constructed of concrete, faced with rubble masonry, and is 170 feet high above the foundation, and 110 feet above the water surface. It is built in deep water against a steep side of the reservoir, and is connected with the land by a causeway carried on four arches.

At the bottom of the tower there are three openings connected with the aqueduct and controlled by throttle valves. Three huge cylindrical strainers fit over these openings, a ring of India rubber at the lower end of the strainer resting on the vertical bell-mouth cast-iron pipe forming the opening. The strainers are about 25 feet high and 9 feet in diameter, and consist of wrought iron frames covered with fine copper wire gauze. Each strainer is cleaned once in 24 hours. For this purpose, it is raised in guides by a hydraulic ram to the washing floor of the tower, where it enters a sheet-iron casing and a large iron pan is swung beneath. The screen is then washed from within by jets of water from a revolving washing turbine or sprayer, the wash-water being conveyed from the pan by suitable scuppers. After washing, the pan is swung down and the screen lowered again and put into service. The whole operation is controlled by an ingenious interlocking system that prevents mistakes in the order of operations. The water for driving the rams and for washing is obtained from a tank on the hill, 110 feet above the tower.

The water enters the tower from the reservoir through a U-shaped 36-inch pipe imbedded in the wall at the bottom. On top of this pipe, inside and outside the tower, are mounted six 9-foot sections of 36-inch steel pipe with gun-metal faced ends, resting end on end, and forming a continuous stand-pipe from lowest available water to above highest flood level. These pipes are protected by side walls and a grating and furnish a means of drawing water at any desired level by opening the corresponding joint. The pipe sections work in guides and can be raised and lowered by means of a steel shaft which carries 3 radial arms at 6 equidistant levels, engaging 3 corresponding brackets on the pipe sections. By turning the central shaft by a crank at the top, connection with the 3 radial arms and the brackets on the pipe section to be raised is made as indicated by a dial, and all the tubes above the joint where the opening is desired are raised by a chain passing over a sheave to a hydraulic ram.

The Vyrnwy Aqueduct

The aqueduct from the Vyrnwy Reservoir to the distributing reservoirs at Liverpool is 68 miles long and at present delivers about 40,800,000 gallons per day. There are 5 balancing reservoirs on the line, and at these and other points, there are installed self-acting cylindrical valves, as on the Rivington aqueduct, already described. The aqueduct passes through 4 tunnels, 11,700 feet, 4,560 feet, 4,920 feet and 800 feet long, respectively, the last being under the Mersey River. There are 6 river crossings, 6 canal crossings and 13 railroad crossings.

Oswestry Filtration Works

The Vyrnwy water is filtered at Oswestry, in England, just over the Welsh border, about 18 miles east of the reservoir. It has since been regretted that the filter beds were not built at the reservoir, as trouble has been experienced with deposit on the sides of the aqueduct. It was originally thought that the elaborate screening device would clear the water sufficiently and prevent any deposit of this kind.

At Oswestry the aqueduct empties into a reservoir of about 50,000,000 gallons capacity, formed by an earthen dam 1,530 feet long, about 25 feet high and 8 feet wide on top, with a 2 to 1 sodded slope on the outer face and a 2½ to 1 paved slope on the water side. The water surface of the reservoir is about 40 feet above the filter beds and the use of this head to generate power for sand-washing and other purposes has been considered.

There are 12 filter beds, with a total area of 9⅞ acres. They are of concrete, lined and walled with brick. The floor is provided with suitable drains for carrying off the filtered water. These drains are covered with flag stones, and the entire floor with perforated terra cotta stools. Over the stools is a 6-inch layer of gravel, grading from ⅛ inch at the top to ½ inch at the bottom, on top of which is a layer of sand 2 feet 6 inches thick. The water delivered to each filter is measured by a disc gage, on exit in the older beds and on entrance in those more recently constructed. This enables a record of the performance and efficiency of each bed, which cannot be obtained at the Rivington filters. The average rate of filtration is about 8.5 cubic feet per square foot of filtering area per day. From the filter beds the water passes to a filtered water reservoir, and thence to a measuring house, where it is measured by an automatic disc gage before it re-enters the aqueduct.

The filters are operated and cleaned in the same manner as at Rivington, already described. When the thickness of the sand is reduced by repeated scrapings to 12 inches, trial has been made of leaving the sand in place, and removing only the thin top layer before replacing the 18 inches additional depth of washed sand. It was found that too low a filtration rate resulted, although fairly good results were obtained when the bottom sand was first stirred up with rakes or forks.

The sand is washed in an inclined cylinder through which the water passes in one direction and the sand is carried in the other by means of a screw conveyor, which thoroughly stirs up the sand and brings it into contact with the running water. The wash water then passes through a series of flat trays or tanks, in which a large part of the sediment deposits before the water is discharged into a nearby brook. The sand washing with this plant costs about 37.5 cents per cubic yard. The average cost of scraping the top layer of sand and scum from a filter is about $13, or about 30.5 cents per cubic yard.

Cownwy and Marchnant Diversions

As noted in the tabulation of the main features of the reservoir, the run-off from 9.28 square miles of adjacent drainage area is stored in the reservoir, in addition to that from the area above the dam. 7.30 square miles of this additional collection area is located to the south of the reservoir, on the basin of the Cownwy, a small stream entering the Vyrnwy about 3 miles below the dam. The water from the upper portion of this stream is diverted into the Vyrnwy reservoir by means of a low masonry dam, through a tunnel 6,453 feet long. The tunnel is 7 feet in diameter, with a total fall of 15 feet through its length, and can deliver about 144,000,000 gallons per day. This work was completed in 1904 at a cost of $108,960. The other 2.58 square miles of auxiliary catchment area is located to the east of the reservoir, on the Marchnant River, which enters the Vyrnwy about a mile below the dam. By means of a low masonry dam, the run-off from the upper portion of this stream is diverted into the Vyrnwy reservoir through a tunnel 7,345 feet long and 7 feet in diameter. The estimated average quantity of water per day which can be obtained through this diversion is about 4,000,000 gallons. This work was completed in March, 1910, at a cost of $91,200.

Distribution, Consumption and Water Rates.

There are 8 or more service reservoirs in and around Liverpool, fed by mains from the distributing reservoirs at the end of the aqueduct. A few parts of the district cannot be supplied by gravity from the reservoirs, and for these, special provision had to be made to raise water by pumping. In addition to the regular mains, special fire mains are laid in the business portions of the city, and with numerous hydrants, furnish an excellent fire service. As in most English cities, the hydrants are under the sidewalks, a practice which, if universally followed in America, would remove an annoying obstruction from our streets.

The area of the city is about 21 square miles and the total area within the compulsory limits of supply is about 115 square miles. About 900,000 people are supplied with water within the city limits and approximately 100,000 more along the line of the aqueducts. The water rates for domestic supply are based on the assessed valuation of the property, and amount to $25 per year for each $1,000. Water for trade supplies is metered and charged for at the rate of 10 cents per 1,000 gallons.

The daily consumption is, at present, about 36 gallons per capita. The utmost care is taken to prevent water waste, and regular inspections and tests are made at frequent intervals. The water department also requires all fittings that are to be installed to be first examined, approved and stamped by their inspection department.

The writer is indebted to Mr. Joseph Parry, Chief Engineer of the Liverpool Waterworks, for much of the above data and for the privilege of inspecting the works described. He is also under obligation to Mr. F. W. Gaskin, Resident Engineer at Oswestry, to Mr. H. N. Giles, Resident Engineer at Vyrnwy and to Mr. R. A. Adamson, Resident Engineer at Rivington for their kindness in showing him over the works under their charge and furnishing data as to methods and costs of operation.

UNIFORM SCHEME OF ACCOUNTS AND REPORTS FOR WATER SUPPLY ENTERPRISES.

(Fourth Installment.)

By Emil L. Nuebling, Member.

(Being a Digest of the Report of the Committee of the American Water Works Association on the subject.)

CLASSIFICATION OF ACCOUNTS AND INSTRUCTIONS FOR LIABILITIES

31. Funded Debt.
32. Revenues of Future Periods Levied in Advance.
    320. Unclassified Revenues of Future Periods Levied in Advance.
    321. Revenues from Metered Private Service within City.
    322. Revenues from Unmetered Private Service within City.
    323. Revenues from Metered Private Service outside City.
    324. Revenues from Unmetered Private Service outside City.
    325. Revenues from Municipal and Private Water Supply Enterprises.
    326. Revenues from Municipalities.
    327. Revenues from Accessory Enterprises.
    328. Revenues from Funds and Investments.
    329. Sundry Revenues.
33. Customers' Deposits.
    331. Revenue Guaranty Deposits.
    332. Street Main Extension Deposits.
34. Notes and Bills Payable, Revenue Loans, etc.
    341. Notes and Bills Payable.
    342. Other Loan Evidences.
    343. Judgments.
    344. Revenue Refunds.
35. Accounts Payable.
    351. Overdrafts.
    352. Adjusted Claims and Accounts.
    353. Unadjusted Claims and Accounts.
36. Interest Payable and Accrued.
    361. Interest on Funded Debt.
    362. Interest on Notes and Bills Payable, Revenue Loans, etc.
    363. Interest on Accounts Payable.
37. Dividends and Other Appropriation of Profits.
    371. Dividends on Debenture Stock.
    372. Dividends on Preferred Stock.
    373. Dividends on Common Stock.

    374. Appropriations to Individual Owners and Firm Members.
38. Nominal Liabilities.
    381. Contingent Liabilities.
    382. Contractual Obligations.
    383. Governmental Appropriation Liabilities.

INSTRUCTIONS FOR USE OF ACCOUNTS.

3. LIABILITIES.

The general accounts provided for liabilities are eight in number, and cover three groups of liabilities, as follows:

I. Fixed debt, included in account 31.
II. Current debts, included in account 32 to 37.
III. Nominal liabilities, included in account 38.

Each of these accounts is explained, and the instructions for its use are set out, under their respective numbers.

Funded debt. The general account with funded debts may be given as many subgeneral accounts as may be found most convenient to provide in detail the information called for by the specifications stated in the succeeding paragraph, and will naturally be included among the following as their most prominent heads:

311. First Mortgage Bonds,
312. Second Mortgage Bonds.
313. Third Mortgage Bonds,
314. Debentures,
315. Municipal Bonds.

The obligations to be recorded in the accounts mentioned in 311, 312 and 313 are sufficiently explained by their titles. They include bonds running for more than one year from the date of issue, which have a mortgage or other lien as security to enforce their payment. The term "debentures," the designation for subgeneral account 314. is the designation here applied to all portions of the funded debt which rests only on the general credit of the corporation or individual issuing the same and is not specially secured or supported by liens of any character. Debentures thus include promissory notes not secured by mortgages or other liens, having more than one year to run; also those securities commonly known as plain bonds. Account 315, municipal bonds, is provided for recording all long term bonds issued by municipalities for their enterprises.

The accounts with fixed debts should be so arranged as to disclose the four following characteristics: (1) Mortgage or other lien, or security therefor or otherwise, as called for by the classification given above; (2) rate of interest; (3) interest dates; and (4) date of maturity. A separate sub-account should be arranged for each group of debt classified as called for by (2), (3) and (4), and no two amounts of debts not agreeing in respect to all four characteristics above mentioned should be included in the same sub-account. The title of each sub-account of funded debt should express the four characteristics above stated, and should be numbered in some proper order, each such number of account, however, to have its first three digits to correspond with the subgeneral account in which the account is to be summarized.

To the appropriate sub-account of funded debt should be credited when issued, the par value of the amount of evidence of funded indebtedness issued. The entry should show not only the amount issued, but the purpose for which issued, and should make intelligible reference to the book page and account wherein are shown any discounts or premiums paid or realized on account of the amount issued. If the consideration received is anything else than money, the entry should further show the person to whom issued, and should describe with sufficient particularity to identify the actual consideration received for the issue. If the issue is in any case to an agent of an individual principal, the name and address of such agent and the fact of his agency should also be shown in the entry.

Revenues of future periods levied in advance.

When bills for water rates, or other revenues, are rendered and collected in advance of the accrual of the service, the revenue accounts should be so kept as to show the amount of such revenue that appertains to future periods. The amount thus appertaining to future periods constitutes a liability, and should be so shown in the balance sheet. In the preparation of that sheet the amounts of revenue recorded in revenue accounts as for future periods may be summed up directly from the revenue accounts, but the better method is to sum them up through a special liability account, for which purpose this account 32 and the subgeneral accounts 320 and 329 hereunder, are provided. As to the manner in which entries are carried into this account, see instructions for the use of account 24, under paragraph (*a*).

At monthly or other stated periods for which statements of results are made up, there should be debited to each of the subgeneral accounts hereunder an amount or amounts which represent the net collectible revenue, as originally entered therein, which has accrued during the fiscal period just ended, and a like amount or amounts should be credited to the proper subgeneral account under operating revenue account 5 and under miscellaneous revenue account 7. This entering of amounts as stated above from period to period must be continued until the end of the period for which the revenue of the future period has been reached, when the last debit to this account should be equivalent to the credit balance shown in the account.

For convenience in subdividing and separately accounting the several classes of revenues for future periods levied in advance ten subgeneral accounts are provided. As to the scope of each of these accounts see instructions for use of accounts 240 to 249. The ten subgeneral accounts hereunder provided are as follows:

320. Unclassified Revenues of Future Periods Levied in Advance.

321. Revenues from Metered Private Service within City.
322. Revenues from Unmetered Private Service within City.
323. Revenues from Metered Private Service outside City.
324. Revenues from Unmetered Private Service outside City.
325. Revenues from Municipal and Private Water Supply Enterprises.
326. Revenues from Municipalities.
327. Revenues from Accessory Enterprises.
328. Revenues from Funds and Investments.
329. Sundry Revenues.

Customers' deposits.

This account and the subgeneral accounts hereunder should be credited with all amounts deposited by customers for the purposes stated below. Separate sub-accounts classified according to the purpose of the deposit should be kept with each individual depositor, and such accounts should show the date of the deposit, amount, purpose, etc., and at the end of each fiscal period the amount of interest accruing thereon, if such interest accrues. Two subgeneral accounts are provided, one for each of the principal classes of deposits met with in the conduct of a water supply enterprise, but additional subgeneral accounts with appropriate numbers may be provided by each enterprise for other classes of deposits.

331. Revenue Guaranty Deposits: Credit this account with the amount of all deposits received from customers of the enterprise for the purpose of guarantying the payment of water and all bills, and with all interest, if any, accruing thereon, and debit with all amounts of such deposits refunded to the depositing customers, and with all amounts applied to the payment of water or other bills accrued against and due by such depositing customers. Any convenient subdivisions under this account may be used, as primary accounts numbered from 3310 to 3319.

332. *Street Main Extension Deposits:* In many water supply enterprises the practice is, when an extension of water mains is requested from which not sufficient revenue can be immediately obtained to justify the investment in the extension, to require of the applicant for such extension a deposit of an amount equivalent to the difference between the amount which the enterprise is justified in investigating in such extension, and the total cost thereof, such amount or deposit to be held by the enterprise subject to refund either with or without interest, either in lump or from time to time in instalments, as the number of connections to such extension are added to and the revenue accordingly increases. Credit this account with the amount of all deposits received as above stated, and also with all interest , if any, accruing thereon, and debit with the amounts refunded to such depositors.

Notes and bills payable, revenue loans, etc.

Under this account or the proper subgeneral accounts hereunder, governmental enterprises should record either in separate accounts or under separate heads (1) all short term loans evidenced by an instrument called "bond," whether specifically designated "revenue loans," "temporary loans," "anticipation tax loans," "anticipation tax warrants," or by any kindred designations; (2) all outstanding warrants or orders on the treasurer; and (3) all judgments payable. Private enterprises should record in the same account or in the appropriate subgeneral accounts hereunder (1) all short term loans payable from current revenue; (2) all receivers certificates; (3) all other short term formal obligations in writing payable from revenues; and (4) all judgments payable. In addition to the aforegoing there should be credited to this account all amounts found to have been collected as revenue in error but which for some reason is not immediately refunded, as explained in instructions for account 24 under paragraph (*h*). Subgeneral accounts for recording in detail data includible hereunder are provided in sufficient number for the average enterprise, but additional subgeneral accounts for additional purposes includible hereunder may be provided where needed. The following subgeneral accounts are explained above:

341. Notes and Drafts Payable.
342. Other Loan Evidences.
343. Judgments.
344. Revenue Refunds.

The accounts with these obligations should be kept substantially as directed in the case of funded debt, account 31, so far as the character of the obligation calls for the same.

Accounts payable.

Three subgeneral accounts are provided under this account for recording data relating to accounts payable, other than interest and dividends, which latter are to be recorded in accounts 36 and 37.

351. Overdrafts: Record under this account the amount of all overdrafts, whether due to banks or elsewhere.

352. Adjusted Claims and Accounts: Private enterprises should record in this account all audited or adjusted but unpaid bills or claims of creditors other than overdrafts, and governmental enterprises should record all similar claims and bills for which no formal warrant has been issued. The formal warrants issued are includible in account 34. Interest and dividends accrued, as stated above, are includible in accounts 36 and 37.

353. Unadjusted Claims and Accounts: Enterprises should record under separate primary accounts hereunder the accrued but unpaid taxes, franchise dues and kindred claims, and all unsettled damages to persons and property of others that result from extraordinary casualties whose amounts are considerable but can be stated in accounts only by estimates. The claims last mentioned are sometimes called "reserves," but they should be recorded under some designation which will disclose their real character. All other unadjusted pending claims should, if accrued and due, be recorded in the same account. Claims which have not accrued and are not due should, however, have no place in this or any account hereunder. Primary accounts for recording the usual data includible in this subgeneral account follow, but additional primary accounts and subprimary accounts may be added to meet any requirements.

3531. Unadjusted Creditors' Accounts.
3532. Unadjusted Claims and Liabilities.
3533. Accrued Insurance Unpaid.
3534. Accrued Rents Unpaid.
3535. Accrued Water Diversion, Right Charges Unpaid.
3536. Accrued Water Power Right Charges Unpaid.
3537. Accrued Taxes Unpaid.
3538. Accrued Franchise Dues Unpaid.

Interest payable and accrued.

This account and the subgeneral accounts hereunder are provided for recording at the close of each fiscal period the amounts that have accrued as interest payable for the use of credit capital by the enterprise, and the amounts paid during such period on account of past accrued interest. The interest accrued and payments should be segregated as called for by the titles of the following subgeneral accounts:

361. Interest on Funded Debt.
362. Interest on Notes and Bills Payable, Revenue Loans, etc.
363. Interest on Accounts Payable.

Dividends and ther appropriations of profit.

This account and the subgeneral accounts hereunder are provided for recording the amounts of all dividends declared and other appropriations of profits made, and the payments thereof are called for by such apportionment. The accounts hereunder are arranged for enterprises operated by corporations, individual owners and by firms. Municipally operated enterprises will have no use for any of these accounts since all purposes served by them will be secured by accounts 253, "current transactions with city." The dividends declared and appropriations made, and payments thereof should be segregated as called for by the titles of the following subgeneral accounts:

371. Dividends on Debenture Stock.
372. Dividends on Preferred Stock.
373. Dividends on Common Stock.
374. Appropriations to Individual Owners and Firm Members.

Nominal liabilities.

This account is provided for summing up the amount of nominal liabilities of a water supply enterprise operated by a municipality or a private corporation. The nominal liabilities are of three general classes, here designated as contingent liabilities, contractual obligations and governmental appropriation liabilities. The first is a debt liability and other two trust liabilities.

381. Contingent Liabilities: This account should be credited with all contested taxes, judgments, claims for damages, and kindred claims which the management believe can be successfully resisted. Such portion of the same claims as it is believed will be enforced against the enterprise should be recorded in account 353 for "unadjusted claims and accounts." All credits to the account of contingent liabilities should be balanced by corresponding debits in account 297 with "contingent assets," and in like manner the contingent assets account should have credits balancing all debit entries in this account.

382. Contractual Obligations: This account is provided for private corporation enterprises which have contracted to maintain sinking funds or sinking fund reserves, or funds or reserves for other specified purposes. The entries in the account are always contra to those in account 298 with "authorized provisions for contratcual obligations." The credit entries in this account should give in detail the amounts of the several contractual obligations existing in the case of any enterprise, and show to what extent those obligations of the current and past years have been met by transfers from unreserved surplus to account with surplus reserves for the purposes stated in the contractual obligations.

383. Governmental Appropriation Liabilities: This is an account provided for summing up accounts with liabilities on contracts, liabilities on open market orders, and unencumbered appropriation balance in governmental account with liabilities under appropriation acts. The total of the amounts recorded in the three accounts mentioned, and is also identical with the records of the nominal asset account 299, "authorized provisions for governmental appropriations." The three accounts mentioned above are treated as primary account subdivisions of this account 383, as follows:

3831. Liabilities on Contracts: Credit this account and debit account 3833, "unencumbered appropriation balances," with any contingent liabilities as incurred by leasehold and other contracts made for or by the enterprise in consonance with the terms of the appropriations. When materials or services called for by the contract are received, debit this account and credit account 299. At the same time the proper expense and outlay account should be debited and credited.

3832. Liabilities on Open Market Orders: Credit the account and debit account 3833, "unencumbered appropriation balances," with all contingent liabilities assumed by open market orders for services and materials. Other entries made with reference to such orders are substantially as set forth above for account 3831, "liabilities on contracts."

3833. Unencumbered Appropriation Balances: This account should be credited and the account 299, "authorized provisions for governmental appropriations," should be debited with the amounts of all appropriations. This account should be provided with a sufficient number of subordinate accounts, numbered 38331 to 38339,, or 3833*a*, 3833*b*, etc., each with a specific designation, to keep record of the expenditures under the specific provisions of the appropriation acts. This may be done by recording the appropriation liabilities in parallel columns with those for expenses and outlays. Among the subdivisions that should be maintained in this account are those showing the amount of contractual obligations for which appropriation account made provision. This account should be kept exactly as stated above for the account with contractual obligations of private enterprises. This account, or its appropriate subdivision should always be debited by amounts of contingent liabilities assumed on contract, and account 3831 credited, and likewise this account be debited by amounts of contingent liabilities assumed by open market orders and account 3832 credited. The credits of this account and of the two other accounts here mentioned should always equal the aggregate of the debit entries in account 299, "authorized provisions for governmental appropriations."

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Engineers' Society of Pennsylvania

Vol. III. JANUARY, 1911 No. 1.

PROCEEDINGS

JANUARY MEETING

The regular annual meeting for the installation of the president for the year 1911, was held on Monday evening, January 16th, 1911, at eight o'clock in the Assembly Hall of the Society. Mr. J. V. W. Reynders, the retiring president, presiding.

The regular order of business was carried out and annual reports were read from the Membership Committee, Publication Committee, Editorial Staff and the Treasurer. After numerous motions of approval and thanks had been passed, the retiring president made the address given in the first part of this issue.

The newly elected president, Mr. David E. Tracy, spoke as follows:

"Gentlemen: I wish to thank you for the honor conferred upon me in selecting me as your President for the coming year, as I surely consider it an honor to preside over such a body of men.

As taxpayers I want to thank you for the portion you will pay towards the noisy demonstration upon our streets this evening, incident to my inauguration. (The night before Governor Tener's inauguration.) It surely seems to be a case of "me and the Governor." (Laughter and applause.)

Seriously speaking we can congratulate ourselves upon the results of our efforts of a very few years. We have an organization second to none of its kind in the State. We have a Journal of which any engineers' society would be proud, although it is only in its infancy. I am sure that our Lecture Committee would gladly welcome an opportunity to arrange for discussions or papers on any engineering or kindred subject. Personally I would be delighted if our membership would awake to the fact that we have members capable of writing papers worthy of being printed in any engineering Journal. At least let us start with family discussions on engineering subjects.

I would like very much to see our younger members become imbued with this spirit as it would be to their benefit as well as for the good of the society as a whole. Your Board of Directors is anxious to make the home of this Society as instructive and entertaining as the resources of the Society will permit and you can co-operate very materially by making suggestions to them, which in your good judgment would assist in attaining their desire. I would ask that the various committees organize as quickly as possible and plan their campaign for the coming year, as success or failure depends to a great extent upon the results obtained by them through co-operation with the officers and Board of Direction. Let co-operation be our password for the coming year and success will follow."

Further business was then discussed and numerous suggestions were forthcoming, relative to the best manner in which to provide the members with synopses of future lectures in time to allow them to prepare questions to ask when the lecturer would be present to answer them. The seemingly best solution being offered by Mr. Thomas Abbott Baldwin, who suggested that the Lecture Committee secure these outlines in time to allow them to be read at the regular meeting next preceding the delivery of the lecture, so that members interested might attend the first reading and have the intervening time to prepare the questions. After some minor announcements the following committees were appointed for the year 1911:

MEMBERSHIP—Mason D. Pratt, Chairman; John Gastrock, D. L. Diehl, George H. Dunham, Gilbert S. Vickery, George H. Brown, Thomas Fleming, Jr., Pittsburg; C. D. Weirbach, Allentown; Frank C. McKibben, South Bethlehem; John Price Jackson, Bellefonte.

HOUSE—Thomas Earle, Chairman; P. A. Cuenot, George H. Dunham, George A. Hall, S. W. Bradshaw.

ENTERTAINMENT—Charles L. Andrews, Chairman; Dick Oliver, E. B. Betser, M. D. Pratt, H. B. Shreiner, George K. Reel.

LIBRARY—J. M. Fair, Chairman; John O'Connell, Edward C. Smith.

STEREOPTICON—J. W. Weaver, Chairman; W. W. Heister.

LECTURE—Farley Gannett, Chairman; W. P. Starkey, J. C. Thompson, Paul Hooker, C. P. Turner, John C. Reed, George R. Bentley.

EXCURSION—Meier G. Hilpert, Chairman; C. I. Bausher, Frank C. Carroll, Robert H. Irons, F. B. Musser.

PUBLICATION—Charles H. Mercer, Chairman; S. H. Noyes, Secretary; W. P. Starkey, G. S. Vickery.

OUT OF TOWN PUBLICATION COMMITTEE—J. Murray Africa, Huntingdon; Thomas J. Brerton, Chambersburg; Benjamin E. Briggs, Erie; A. W. Drake, Lattimer Mines; Murray Forbes, Greensburg; W. C. Hawley, Wilkinsburg; James B. Hogg, Connellsville; Harvey Linton, Altoona; Lee Masterton; Charles F. Mebus, Philadelphia; C. D. Wierbach, Allentown; C. H. Milholland, New Castle; William P. Mitchell, Lock Haven; H. B. Norton, Ridgeway; Emil Neubling, Reading; Marshall R. Pugh, Philadelphia; F. H. Shaw, Lancaster; H. S. Smith, Wilkes-Barre; William R. Smith, Jr., York; N. S. Sprague, Pittsburg;

Edward M. Stack, Scranton; Elton D. Walker, State College; D. F. A. Wheelock, Warren.

EDITORIAL STAFF—F. Herbert Snow, Chairman; John M. Mahon, Jr., Secretary; Meier G. Hilpert, W. P. Mackenzie, Samuel K. Varnes, W. B. McCaleb, J. Horace McFarland, Frank A. Robbins, Jr., Vance C. McCormick, A. Boyd Hamilton.

EDWARD R. DASHER,
Secretary.

LECTURE COMMITTEE

Mr. A. P. Steckel, E. E., Consulting Engineer of New York, will on the evening of February 13, 1911, lecture in the Assembly Hall of the Society at 8 o'clock on the Humphrey Gas Pump. This is perhaps the most valuable lecture that this Society has ever secured and as it is to be given on a regular meeting night, the Committee looks forward to a full attendance and assures every member interested in this subject that it will repay any effort which they may exert to be present.

The Humphrey Gas Pump was invented by Dr. Mond, who is famous for his by-product gas producer. The development of the invention was completed by Dr. Humphrey, who has been for some years connected with the Mond interests in England.

It is firmly believed by many engineers of promimence that the Humphrey Pump promises to revolutionize present pumping methods, and that its possibilities as an air compressor and in other fields is almost equally as good.

Papers have been presented before the English Institute and before one of the Journal Societies dealing with this invention, but this is the first presentation of any data upon the subject before an American engineering society. We are doubly fortunate to be able to secure an engineer of the ability and prominence of Mr. Steckel to present a paper dealing with so important a subject.

FARLEY GANNETT,
Chairman Lecture Committee.

Engineers' Society of Pennsylvania

Vol. III. FEBRUARY, 1911 No. 2.

PROCEEDINGS

FEBRUARY MEETING.

The regular monthly meeting of the Society was called to order by the President, Mr. Tracy, on February 13, 1911.

The reading of the minutes of the last regular meeting was dispensed with, on motion.

The Secretary announced the election on February 11th, of the following new members:

Mr. F. I. Kimball, non-resident member.

Mr. Edward J. O'Brien, non-resident member.

The President appointed the following members as an Auditing Committee to audit the books of the Treasurer and Secretary for the year 1910.

Mr. Mason D. Pratt, Chairman; Mr. W. P. Starkey, Mr. George R. Bentley.

The President introduced the lecturer of the evening, Mr. A. P. Steckel, E. E., Consulting Engineer, Wheeling, W. Va., who delivered an illustrated lecture on "The Humphrey Gas Pump."

The retiring Chairman of the Lecture Committee announced that the next lecture would be given on March 13th, following the regular monthly meeting, by Mr. C. Pirtle, C. E., of the Electric Controller & Manufacturing Co., Cleveland, Ohio, on "Simplified Automatic Controllers."

No further business coming up the meeting was adjourned.

Edward R. Dasher,
Secretary.

LECTURE COMMITTEE

Talks on Highways and Highway Department Organization.

In conjunction with the Chairman of the Committee of the House of Representatives, the Lecture Committee of the Society has arranged for an evening to be devoted to the discussion of State Highways and the Organization of State Highway Departments. This meeting will be held in the House of Representatives, on Tuesday evening, March 7, 1911, at 8 o'clock, the House having passed a resolution, presented by Hon. E. E. Jones, Chairman of the House Committee on Public Highways, granting the use of the House of Representatives for that purpose.

The meeting will be addressed by three or four speakers, representing the Federal Bureau of Highways and other State and Municipal Highway Bureaus. Among the speakers are Logan Walter Page, Chief of the Bureau of Highways, U. S. Department of Agriculture; Walter B. Thompson, Division Engineer, P. R. R., Elmira, N. Y., who is the P. R. R. highway expert; John Price Jackson, Dean of the Engineering School of State College, who is in charge of the "Highway Special Train" now touring the State in the interest of good roads. Other probable speakers are F. D. Lyons, Assistant Chief, Department of Highways of New York State, and Director Stearns, of the Bureau of Public Works of Philadelphia.

This meeting is being arranged to assist in the movement now in progress in Pennsylvania, toward effecting an extensive system of State roads.

The Society extends an invitation to all who are interested in this subject to attend, and is inviting the Harrisburg Board of Trade and Automobile Clubs. The papers presented at this meeting will be published in a special "Highway Number" of the Proceedings.

FARLEY GANNETT,
Chairman Lecture Committee.

Engineers' Society of Pennsylvania

VOL. III. MARCH, 1911 No. 3.

PROCEEDINGS

MARCH MEETING

The regular monthly meeting of the Society was called to order by Mr. Mason D. Pratt, in the absence of the President, Mr. Tracy, on Monday evening, March 13, at eight o'clock.

The minutes of the last regular meeting were read and approved.

The election of thirteen new members was announced by the Secretary.

The report of the Auditing Committee, appointed by the President at the February meeting, was read and on motion the report was approved and filed, the Committee being discharged with a vote of appreciation.

The lecturer of the evening, Mr. C. Pirtle, Electrical Engineer, was then introduced. After the lecture and a general discussion the meeting was adjourned.

EDWARD R. DASHER,
Secretary.

LIBRARY COMMITTEE.

List of Periodicals on the Table in the Reading Room.

American Machinist.
Architectural Record.
Cassier's Magazine.
Compressed Air.
Electrical Railway Journal.
Engineering News.
Engineering Record.
Foundry.
American Magazine.
Century Magazine.
Collier's Weekly.
Country Life.
Cosmopolitan.
Everybody's.
Harper's Monthly.
Iron Age.
Electrical Review.
Electrical World and Engineer.
Engineering and Mining Journal
Engineering (London).
Railroad Age Gazette.
Scientific American.
Scientific American Supplement.
Little Journeys.
McClure's.
Munsey's.
Outing.
Outlook.
Philistine.
Puck.

Harper's Weekly.
Judge.
Leslie's Weekly.
Life.
Literary Digest.
Review of Reviews.
Saturday Evening Post.
Scribner's.
Success.
World's Work.

These publications are sent to us free of charge:

U. S. Patent Office Reports (annual and monthly).
Journal of the Engineering Society of Western Pennsylvania.

The State Collegian (Pennsylvania State College).
The Polytechnic (Rensselaer Polytechnic Institute).

The following is a list to date of the exchanges with thi Society:

American Society Civil Engineers.
American Society Mechanical Engineers.
American Water Works Association.
American Railway Engineers' M. W. Association.
American Iron and Steel Association.
American Inst. Mining Engineers.
Boston Society Civil Engineers.
Brooklyn Engineers' Club.
Cornell Civil Engineer.
Engineers' Club of Philadelphia.
Engineers' Society of Western Pa.
Harvard Engineering Journal.
Journal Association Engineering Societies.
Journal Franklin Inst.
New England Water Works Association.
Proceedings Engineers' Association of South.
Proceedings American Electrical Engineers.
Professional Memoirs, U. S. Army.
School of Mines, Columbia University.
Sibley Journal of Engineering.
St. Louis Railway Club.
Stevens Inst. Indicator.
Technology Quarterly.
Univ. of Ill.
Western Society of Engineers.
Engineering Record.

FRANK H. MONATH,
Chairman Library Committee

MEMBERSHIP COMMITTEE

The following persons have been elected to membership in this Society:

Arthur Curtis Seymour, ...Resident Member.
Frederick Baird Adams, ...Non-Resident Member.
Edward Howard Cahill, ...Non-Resident Member.
William Irvin Reed, ...Resident Associate Member.
John J. Donegan, ...Resident Associate Member.
Edward Easson Goodwillie, Resident Associate Member.
Frank Henry Kelley, ...Resident Associate Member.
Lewis B. Lindemuth, ...Resident Associate Member.
Raymond Livingston Gillespie, Res. Associate Member.
William Winsor Philler, ..Resident Associate Member.
Walter Thomas Arms, ...Resident Associate.
G. Archer Kroener, ...Non-Resident Associate.
Harry John Bell, ...Non-Resident Associate.

MASON D. PRATT,
Chairman Membership Committtee.

Engineers' Society of Pennsylvania

VOL. III. APRIL, 1911 No. 4.

PROCEEDINGS

APRIL MEETING

The regular monthly meeting of the Society called to order by the President, Mr. Tracy on Monday evening, April 10, at 8 o'clock.

The minutes of the previous meeting were read and approved.

The Secretary announced the election on Saturday, April 8, 1911, of the two new members.

Under the head of new business a general discussion was entered into by the members as to the best means to secure a greater interest in the advancement of the Society.

A motion was made by Mr. Mercer, seconded by Mr Cuenot, that a Special Committee of 12 to 15 members, who are not at present on any other committee be appointed to arrange for discussions on various subjects by the members, either weekly or bi-weekly. This was agreed to.

A motion was made by Mr. Snow, seconded by Mr. Hooker, that a Committee of 15 members be appointed A Special Committee on Current Literature, to peruse Enginering publications and make excerpts or notes relative to matters new or of particular importance to the profession and to submit the same to the Board of Editors and to the Special Committee authorized to conduct a series of special talks and discussions at the Club rooms weekly or bi-weekly. This was agreed to.

No further business being brought forward the meeting was adjourned.

EDWARD R. DASHER,
Secretary.

MEMBERSHIP COMMITTEE

The following persons were elected to membership in this Society on April 8, 1911:

Francis Asbury Awl,	Resident Member.
Raymond A. Walter,	Non-Resident Member.

MASON D. PRATT,
Chairman Membership Committee.

LIBRARY COMMITTEE.

List of Periodicals on the Table in the Reading Room.

American Machinist.
Architectural Record.
Cassier's Magazine.
Compressed Air.
Electrical Railway Journal.
Engineering News.
Engineering Record.
Foundry.
Iron Age.
Electrical Review.
Electrical World and Engineer.
Engineering and Mining Journal
Engineering (London).
Railroad Age Gazette.
Scientific American.
Scientific American Supplement.

The following is a list of Bulletins recently received and placed in the Reading Room, in addition to the Patent Office reports received regularly:

Department 402, The Utilization of Fuel in Locomotive Practice.
Bulletin 392, Commercial Deductions from comparisons of Gasoline and Alcohol Tests on Internal-Combustion Engines.
Bulletin 343, Binders for Coal Briquets, Investigations made at the Fuel Testing Plant, St. Louis, Mo.
Bulletin 363, Comparative Tests of Run-of-Mine and Briquetted Coal on Locomotives, including Torpedo Boat tests and some Foreign Specifications for Briquetted Fuel.
Bulletin 366, Tests of Coal and Briquets as Fuel for House-Heating Boilers.
Bulletin 385, Briquetting Tests at the United States Fuel Testing Plant, Norfolk, Virginia, 1907-8.
Bulletin 412, Tests of Run-of-Mine and Briquetted Coal in a Locomotive Boiler.
Bulletin 383, Notes on Explosive Mine Gases and Dusts, with Special Reference to Explosions in the Monogah, Darr and Naomi Coal Mines.
Bulletin 367, The Significance of Drafts in Steam-Boiler Practice.
Department of the Interior, Bureau of Mines.
Bulletin 1, The Volatile Matter of Coal.
Bulletin 2, North Dakota Lignite as a Fuel for Power-Plant Boilers.
Bulletin 3, The Coke Industry of the United States as Related to the Foundry.
Bulletin 4, Features of Producer-Gas Power-Plant Development in Europe.
Bulletin 5, Washing and Coking Tests of Coal.
Bulletin 9, Recent Development of the Producer-Gas Power Plant in the United States.
Bulletin 11, The Purchase of Coal by the Government under Specifications with Analyses of Coal delivered for the Fiscal Year 1908-1909.
River and Harbor Improvements Under the Corps of Engineers, U. S. Army.

These publications are sent to us free of charge:

U. S. Patent Office Reports (annual and monthly).
Journal of the Engineering Society of Western Pennsylvania.

The State Collegian (Pennsylvania State College).
The Polytechnic (Rensselaer Polytechnic Institute).

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Engineers' Society of Western Pa.
Harvard Engineering Journal.
Journal Association Engineering Societies.
Journal Franklin Inst.
New England Water Works Association.
Proceedings Engineers' Association of South.
Proceedings American Electrical Engineers.
Professional Memoirs, U. S. Army.
School of Mines, Columbia University.
Sibley Journal of Engineering.
St. Louis Railway Club.
Stevens Inst. Indicator.
Technology Quarterly.
Univ. of Ill.
Western Society of Engineers.
Engineering Record.

FRANK H. MONATH,
Chairman Library Committee.

Engineers' Society of Pennsylvania

Vol. III. MAY, 1911 No. 5.

PROCEEDINGS

MAY MEETING.

The Regular monthly meeting of the Society called to order by the President, Mr. Tracy, May 15, 1911, in the Assembly Hall.

On motion the reading of the minutes of the previous meeting was dispensed with.

The Secretary announced the election of three new members by the Board of Direction.

The President announced the dates of the Third Annual Convention, to be held at State College, June 7th, 8th, 9th and 10th, the preliminary announcement and program for which follows.

No further business, the meeting adjourned.

Edward R. Dasher,
Secretary.

ANNOUNCEMENT THIRD ANNUAL CONVENTION, STATE COLLEGE, PA., JUNE 7, 8, 9 and 10, 1911.

The Third annual Convention of Pennsylvania Engineers, under the auspices of the Engineers Society of Pennsylvania, for the furtherance of the organization of the Engineers of the State will be held at State College, Pa., on June 7, 8, 9 and 10, 1911.

A program of exceptional professional interest, supplemented by an inspection of the facilities of State College, and social gatherings, should make it a most valuable as well as an enjoyable Convention.

The program for the ladies will be especially pleasing, and they are urged to attend. The professional sessions have been arranged by a Committee of the College, with Dean John Price Jackson as Chairman.

Preliminary Program.

Wednesday Evening, June 7.

7.30 to 10.30 P. M.—Registration and Formal Reception to the Visiting Members by the Local Reception Committee.

Thursday, June 8.

8.00 A. M.—Registration.

9.00 A. M.—Calling of the Convention to order, with Opening Remarks by the Chairman.

Address of Welcome, James A. Beaver, President of the Board of Trustees, of the Pennsylvania State College.

Address of Welcome in behalf of the Alumni.

Response in behalf of the Convention, by Mr. David E. Tracy, President of the Engineers' Society of Pennsylvania.

Remarks by Representatives of the various Pennsylvania Societies on the value of Federation of State Engineers.

11.30 A. M.—Preliminary Business Meeting of the Convention.

Recess for Lunch.

2.30 P. M.—"Late Improvements in Sanitation and Sewage Disposal," with discussion.

"The Modern Project of Illumination," with discussion.

"Industrial Efficiency," with discussion.

8.00 P. M.—Business Meeting, followed by a Smoker, given in honor of the visitors, by the Local Members.

Friday, June 9.

9.00 A. M.—"The Manufacture of High Grade Iron and Steel," with discussion.

"The System of Organization of Pennsylvania Engineers," by F. Herbert Snow, Chief Engineer, State Department of Health. General discussion.

"The Control of Public Utilities."

Recess for Lunch.

1.30 A. M.—Inspection of the facilities of Pennsylvania State College, under the direction of the local Reception Committee.

4.00 P. M.—Discussion of the Engineering Experiment Station.

Address: "Relation of the Engineering Profession," by Edwin Earle Clark, LL. D., President of the Pennsylvania State College.

Address: "Scientific Investigation."

8.00 P. M.—Entertainment by College Pharsonians—Music and Minstrelsy, followed by a dance at the Armory.

Saturday, June 10.

9.00 A. M.—"Some Particular Problems for which the State Engineers are Responsible," with discussion.

10.00 A. M.—Recess to view the Exhibition Military Drill of the State College Cadets.
11.00 A. M.—Convention reassembled.
Discussion of the Highways and Transportation.
12.00 Noon—Final Adjournment.
1.00 P. M.—Track Meet between State and Colgate.
2.30 P. M.—Baseball Game between State and Bucknell.
8.00 P. M.—Entertainment by the Combined State Musical Clubs.
10.00 P. M.—Campus Singing at the Senior Class Benches on the Front Campus.

The names of all speakers and further details will be announced later.

An especially pleasing program will be furnished for the ladies, including automobile rides, dances and receptions.

All persons who will attend the Convention should reserve accommodations in advance. American plan rates, $2.50 and $3.00 per day. European plan, $0.75 to $1.50 per day. Accommodations can be reserved by mailing a request to Charles L. Kinsloe, Department of Electrical Engineering, State College, Pa.

Railway connections and service will be announced later.

Primary Object.

Back of the effort to provide profitable lectures, useful information and entertainment for the Engineers and their wives, is the primary object of the movement, namely, the perfecting of an organization of the engineering profession of this State as a body. There are hundreds of engineers in the nine hundred boroughs, thirty odd cities and sixty-seven counties of Pennsylvania, who are not associated with any local engineering society, but who stand ready to take a lively interest in what effects their profession and who will participate in a State organization of engineers, provided the cost comes within their means. This class and members of existing societies should be united in the general movement.

That the utmost goodwill and hearty co-operation may exist, that the working out of a code with legislative backing, such as may appear, after due deliberation, to be desirable and representative of the concensus of opinion of the engineers of Pennsylvania, may be accomplished, the attendance of municipal engineers and health officers, water works superintendents, civil, mining, mechanical and electrical engineers, chemists, bacteriologists, manufacturers, managers and superintendents of industrial and transportation corporations, engineering contractors and firms, architects and scientists, is requested to participate in the convention and organization.

EDWARD R. DASHER,
Secretary.

LIBRARY COMMITTEE.

These additional Government Bulletins have been received:

Department of the Interior—United States Geological Survey:
Bulletin No. 336—Washing and Coking Tests of Coal and Cupola Tests of Coke.
Bulletin 423—A Primer on Explosives for Coal Mines.
Department of the Interior—Bureau of Mines:
Miners' Circular 2—Permissible Explosives Tested Prior to January 1, 1911, and Precautions to be taken in their use.
Bulletin 8—The Flow of Heat Through Furnace Walls.

EDWARD C. SMITH,
Chairman.

MEMBERSHIP COMMITTEE

The following persons were elected to this Society at the last meeting of the Board of Direction:

Charles Adam Thistlethwaite.
Clark Olds.
John Hull Decher.

MASON D. PRATT,
Chairman Membership Committee.

Engineers' Society of Pennsylvania

Vol. III. JUNE, 1911 No. 6.

PROCEEDINGS

POSTPONEMENT OF CONVENTION

As stated in the circulars issued by the Society, it was deemed advisable to postpone the annual convention, owing to the many conflicting dates occurring at that time, such as college commencements, alumni meetings and class reunions, and particularly the conventions of the Mining Engineers, Mechanical Engineers and the American Water Works Association.

Edward R. Dasher,
Secretary.

REGULAR MONTHLY MEETING

The next regular monthly meeting of the Society will be held on Monday, September 11th, at eight o'clock in the Assembly Room.

Edward R. Dasher,
Secretary.

MEMBERSHIP COMMITTEE

The following persons were elected to the Society at a recent meeting:

Alan M. Paget,	Resident Associate Member
Wm. G. Orr,	Non Resident Associate

Mason D. Pratt,
Chairman Membership Committee.

LIBRARY COMMITTEE.

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Country Life.
Cosmopolitan.
Everybody's.
Harper's Monthly.
Harper's Weekly.
Judge.
Leslie's Weekly.
Life.
Literary Digest.
Scientific American.
Scientific American Supplement.
Little Journeys.
McClure's.
Munsey's.
Outing.
Outlook.
Philistine.
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Review of Reviews.
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Boston Society Civil Engineers.
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Engineers' Club of Philadelphia.
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Harvard Engineering Journal.
Journal Association Engineering Societies.
Journal Franklin Inst.
New England Water Works Association.
Proceedings Engineers' Association of South.
Proceedings American Electrical Engineers.
Professional Memoirs, U. S. Army.
School of Mines, Columbia University.
Sibley Journal of Engineering.
St. Louis Railway Club.
Stevens Inst. Indicator.
Technology Quarterly.
Univ. of Ill.
Western Society of Engineers.
Engineering Record.

EDWARD C. SMITH,
Chairman Library Committee

CHARLES WILLIAM REINOEHL.

On October 9th, 1910, Charles William Reinoehl, Superintendent of the Frog and Switch Department, The Pennsylvania Steel Company, was killed in an automobile accident in New Jersey while on his way to Atlantic City.

Mr. Reinoehl was born at Lancaster, Pa., April 8, 1860. In 1871 his parents moved to Harrisburg, Pa. and he attended the Public Schools. His first connection with The Pennsylvania Steel Company was in 1880, when he secured employment as a planer hand. He continued in this capacity for thirteen years, and by his exemplary conduct and keen interest in his work drew to himself the favorable notice of his superiors. In 1893 he was assigned to take charge of the Company's Exhibit at the World's Fair in Chicago, subsequently being engaged as traveling representative. On January 15th, 1902, he was appointed Sales Agent at Steelton, Pa. On the retirement of Mr. G. W. Parsons, Mr. Reinoehl received the recognition of his business abilities by his selection as Superintendent of the Frog and Switch Department, January 1, 1904. The new shops at the East End had been completed and the Company was reaching out to secure business for its increased capacity. On these conditions, the new Superintendent brought to bear all his energies and powers of organization, and the result was soon apparent in a steady growth of every branch of the Frog and Switch Department.

Mr. Reinoehl was widely known throughout the United States. His magnetic personality secured for him the respectful consideration and in many cases, the affection of men whose only relations with him were of a business nature. There prevailed among his employees an honest admiration and regard for the man who had risen from among them without interposing the barrier of social restraint, and who was watchful of their interests and keenly susceptible of all matters affecting their welfare. As a friend, he was kindly and impulsively generous; as an employer, justly strict in holding his subordinates to their duties, but withal tolerant of human weakness; as a man he was clean-minded and whole-hearted, devoted to his family and willing to make sacrifices that others might enjoy the fruits of his labors.

He was a member of the Engineers' Club, New York City; The Manufacturers' Club, Philadelphia, and the Harrisburg Club, Harrisburg, Pa. He was a charter member of the Engineers' Society of Pennsylvania.

GILBERT S. VICKERY, Member.

Proposals

Harrisburg: Bids will be received by the Harrisburg School Board on January 24 for the construction of two $35,000 school buildings. The one to be known as the Woodward building, will be located at Eighteenth and Herr streets and the other in the Thirteenth ward, as an annex for the Melrose building. C. H. Lloyd, of Harrisburg, is the architect.

Harrisburg: Work will be resumed in the Spring by W. S. Miller on the million-gallon high service reservoir at Reservoir Park and on the new pump house at the park.

Philadelphia: The State Supreme Court has rendered a decision, upholding the opinion of Judge George Kunkel, of the Dauphin county court, in regard to the validity of the factory inspection act of 1909, and which affects many theaters, especially moving picture playhouses, in Pennsylvania. After the passage of the act State Factory Inspector Delaney ordered changes in many theaters in accordance with the new provisions. The A. L. Roumfort Company, Inc., of Harrisburg, backed up by thirty other theater owners, refused and obtained an injunction and on a hearing to make this permanent the plaintiffs claimed that the act was unconstitutional, claiming it to be confiscatory. Judge Kunkel, however, took the opposite view and sustained the law and an appeal was taken.

General

Harrisburg: Six bids were opened by the trustees of the Pennsylvania State Lunatic Hospital for the new women's home for nurses but as none of them came within the appropriation of $55,000 provided for the building, no award was made. The trustees expect to adjust matters without readvertising for bids.

INDUSTRIAL.

Charters

Philadelphia: New Branson Knitting Machine Company, manufacture of machinery; capital, $10,000; treasurer, Jacob Blumberg, 510 Wood street, Philadelphia.

New Castle: Opinn Lumber Company, manufacturing of timber, lumber and articles from the products of the forests; capital, $7,000; treasurer, Jas. T. Ray, New Castle.

Philadelphia: Pearson and Ludascher Lumber Company, manufacturing timber and lumber and mill work and furnishing builders' supplies; capital, $100,000; treasurer, Robert Stevenson, 5347 Bellfield avenue, Philadelphia.

Philadelphia: Seaboard Coal and Coke Company, mining and quarrying coal, clay, ores and other minerals and the manufacture of coke; capital, $5,000; treasurer, Louis Dalmas, Philadelphia.

Galeton, Potter county: Galeton Novelty Company, manufacturing of novelties, such as dish lifters; capital, $5,000; treasurer, James T. Hurd, Galeton.

Philadelphia: Boice-Phillipson Company, Incorporated; manufacturing paper boxes; capital, $6,000; treasurer, W. S. Boice, 4020 Spruce street, Philadelphia.

Philadelphia: The Corby-Cobb Company, manufacturing food products; capital, $20,000; treasurer, Thomas V. Cobb, Philadelphia.

Wilkes-Barre: B. G. Carpenter Company, manufacturing metal ware; capital, $50,000; treasurer, B. H. Carpenter, Wilkes-Barre.

Philadelphia: Artificial Leather and Fabric Company, manufacturing artificial leather, weatherproof cloths and other fabrics; capital, $5,000; treasurer, H. C. DuBois, 1733 Pine street, Philadelphia.

York: Art Sign Company, manufacturing and erecting all kinds of electric and other signs; capital, $10,000; treasurer, H. G. Wiest, York.

Wind Gap, Northampton county: Arvon Slate Company, quarrying and manufacturing slate and slate products; capital, $100,000; treasurer. John A. Eley, Wind Gap.

Philadelphia: Felton, Sibley and Company, Incorporated, manufacturing varnishes and paints; capital, $5,000; treasurer, W. G. Sibley, 6626 McCallum street, Philadelphia.

Philadelphia: General Motor Car Company, construction of automobiles and their parts; capital, $10,000; treasurer, W. G. Herbert, Thirty-sixth and Walnut streets, Philadelphia.

Pittsburg: Moss & Blakeley Plumbing Company, manufacturing plumbing materials; capital, $20,000; treasurer, Harold Mantle, Oak Station.

New Bethlehem, Clarion county: New Bethlehem Fabric Manufacturing Company, manufacturing gloves, merchandise and fabrics made of animal, vegetable and mineral fiber; capital, $15,000; treasurer, G. W. Leach, New Bethlehem.

Prospect, Butler: The Prospect Telephone Company, operating telephone lines in Prospect, Mt. Chestnut, Isle, and adjacent territory; capital, $8,000; treasurer, Elmer Wehr, Prospect.

Indiana: Penn Enamel Sink Company, manufacturing of white enameled kitchen sinks, bath tubs and other articles of a similar nature; capital, $100,000; treasurer, B. W. Stewart, Indiana.

Pittsburg: United States Police and Fire Signal Company, manufacturing signal and information devices for police, fire alarm and messenger business; capital, $5,000; treasurer, Edward Lewis, Ross and Diamond streets, Pittsburg.

Wind Gap, Northampton county: Wind Gap Knitting Company, manufacturing, bleaching and dyeing underwear; capital, $5,000; treasurer, W. H. Rahn, Wind Gap.

Pittsburg: Highland Mantel and Tile Company, manufacturing mantels, fireplaces, chandeliers, lamps, and so on; capital $10,000; treasurer, A. Adelman, 26 Fernando street, Pittsburg.

Greensburg: The Oral Hygiene Products Company, Manufacturing chemicals and medicinal articles; capital, $10,000; treasurer, John H. Crawford, 501 Diamond Bank Building, Pittsburg.

Pittsburg: Pittsburg Auto Show Association; operating exhibitions of automobiles and accessories; capital, $5,000; treasurer, J. B. Howe, Sewickley.

Bangor: Bangor Union Quarry Company, quarrying slate and manufacturing slate products; capital, $20,000; treasurer, William E. Lloyd, Bangor.

Philadelphia: The Williamson Company, carrying on the business of electrical and mechanical engineers; capital, $25,000; treasurer, Charles H. Shay, 1947 Mutter street, Philadelphia.

Philadelphia: Charles E. Shedaker & Sons, manufacturing shirts and underwear; capital, $50,000; treasurer, J. J. Shedaker, 510 West Coulter street, Philadelphia.

Lancaster: The Conestoga Chemical Works, manufacturing chemicals, pharmaceutical preparations and insecticides; capital, $5,000; treasurer, T. Q. Garvey, Lancaster.

Philadelphia: El Grandor Cigar Company, manufacturing cigars; capital, $10,000; treasurer, J. Albert Bach, 1709 Cayuga street, Philadelphia.

Charleroi, Washington county: Lock Four Brick Company, manufacturing of brick and quarrying of stone; capital, $16,000; treasurer, Charles Potter, Donora.

Whitehall, Lehigh county: The Lehigh Silk Dyeing Company, dyeing and treating silk, cotton and other threads and manufacturing chemicals; capital, $50,000; treasurer, P. E. Zinggeler, Allentown.

Pittsburg: Superior Bronze Company, manufacturing iron or steel or other metal and of castings of bronze, brass, copper or iron or steel; capital, $15,000; treasurer, D. V. Sherlock, Pittsburg.

Hazleton: The Schmidt Automatic Electric Air Pump Company; capital, $5,000; treasurer, Isaac Smulyan, Hazleton.

Pittsburg: Wadsworth Airship Company, manufacturing airships and other devices and machines for aerial navigation and transportation; capital, $2,000; treasurer, Frank J. Schellman, 1820 Beaver avenue, North Side, Pittsburg.

Philadelphia: William H. Horn and Brother, Incorporated, manufacturing surgical appliances; capital, $200,000; treasurer, William H. Horn, 3723 North Sixteenth street, Philadelphia.

Slatington, Lehigh county: Big Franklin Slate Company, mining and quarrying slate; capital, $20,000; treasurer, Evan J. Davis, Scranton.

McDonald: Crescent Bottle Company, manufacturing glass and glassware; capital, $16,000; treasurer, E. L. Freet, McDonald.

Reading: Henry R. Miller Company, manufacturing hats; capital, $150,000; treasurer, William A. Mannerback, Reading.

Erie: Herald Paper Box Company, manufacturing boxes and office supplies; capital, $25,000; treasurer, E. J. Neiner, Erie.

Benton: Long Wagon Company, manufacturing carriages and wagons; capital, $25,000; treasurer, O. M. Long, Benton.

Philadelphia: American Phosphorus Company, manufacturing phosphorus and quarrying for minerals that enter into its composition; capital, $50,000; treasurer, H. E. Asbury, Oak Lane, Philadelphia.

Philadelphia: J. A. Schwarz Company, manufacturing jewelry; capital, $50,000; treasurer, Harry Weinreich, 2315 North Park avenue, Philadelphia.

Philadelphia: J. W. Mawby Company, manufacturing carpets and rugs; capital, $20,000; treasurer, J. V. Mawby, 1500 Swain street, Philadelphia.

Williamsport: J. A. L. Minor Building Company, constructing coke ovens, factories and other buildings; capital, $5,000; treasurer, J. A. L. Minor, Williamsport.

Clearfield: Kato Coal Company, mining coal and manufacturing coke; capital, $48,000; treasurer, Isaac B. Norris, Curwensville.

Harrisburg: Myers Plow Point Company, manufacturing plow shares and points; capital, $50,000; treasurer, H. W. Miller, Harrisburg.

Cochranton: The Nonpareil Manufacturing Company, manufacturing lime and fertilizer sowers and other mechanical devices and tools; capital, $15,000; treasurer, J. H. Allison, Cochranton.

Kittanning: Procious Lumber Company; capital, $10,000; treasurer, S. M. Blakeslee, Manorville.

Philadelphia: Scranton Automobile Equipment Company, manufacturing automobiles and other devices; capital, $5,000; treasurer, Coates Coleman, Fifteenth and South Penn Square, Philadelphia.

Blairsville: The Blairsville Foundry Company, manufacturing castings of steel, iron and other metals; capital, $10,000; treasurer, A. W. Shipman, Plainfield, New Jersey.

General

Philadelphia: The capital stock of the Roosevelt Worsted Mills has been increased from $75,000 to $100,000.

Fayette county: The Dawson Bridge Company has filed a decree of dissolution.

Emporium: The Cameron Powder Manufacturing Company has increased its capital stock from $100,000 to $150,000.

Pittsburg: The Pennsylvania Car Wheel Company has filed its intention of decreasing its capital stock from $300,000 to $1,000.

Philadelphia: The Reno Manufacturing Company will increase its capital stock from $10,000 to $30,000.

Harrisburg: The Eureka Electric Light, Heat and Power Company has increased its capital stock from $29,500 to $34,500.

Pittsburg: The Union Switch and Signal Company will increase its capital from $2,500,000 to $5,000,000.

Philadelphia: The Berrodin Rubber Company, of this city, will increase its capital stock from $10,000 to $20,000.

McKean county: The Tri-County Natural Gas Company has decided to increase its capital from $200,000 to $1,200,000.

Beaver county: The Falliston Bridge Company has issued a decree of dissolution.

Philadelphia: The Philadelphia Rubber Works Company will increase its capital from $300,000 to $2,500,000.

Siegfried: The Alliance Hollow Cement Block Company has increased its capital stock from $5,000 to $10,000.

Riddlesburg: An increase of stock from $200,000 to $300,000 has been authorized by the directors of the Colonial Iron Company of this place.

Pen Argyle: The Albion Slate Company has authorized an increase of stock from $16,000 to $36,000.

Franklin: An increase of its stock from $25,000 to $100,000 has been voted for by the directors of the Northwestern Construction Company.

Philadelphia: The Lehigh Coke Company has directed an increase in its capital stock from $300,000 to $15,000,000.

Harrisburg: The Paxtang Quarry Company has increased its indebtedness from $5,000 to $40,000.

Philadelphia: The capital stock of the Philadelphia Stamp Company has been increased from $12,000 to $25,000.

Washington: The Universal Rolling Mill Company has authorized an increase in capital stock from $75,000 to $150,000.

Williamsport: The Williamsport Radiator Company has increased its capital from $30,000 to $200,000.

Butler: The indebtedness of the T. W. Phillips Gas and Oil Company has been increased in the amount of $600,000.

Philadelphia: The Westmoreland Chemical and Color Company has authorized an increase in capital stock from $5,000 to $30,000.

Canton: The Haflett-McNulty Table Company has increased its stock from $50,000 to $100,000.

Reading: The American Die and Tool Company has authorized an increase of its capital stock from $60,000 to $100,000.

Benson: The White Oak Milling Company has decreased its capital stock from $30,000 to $20,000.

Meadville: The Railway Chemical Manufacturing Company has increased its capital from $10,000 to $25,000.

Beaver Falls: The Mayer China Company has increased its capital from $5,000 to $175,000.

Pittsburg: The Crescent Coal Company has authorized a decrease of its capital stock from $200,000 to $100,000.

Bolivar: The directors of the Phenix Fire Brick Company have authorized an increase of the capital stock from $5,000 to $75,000 and the company's indebtedness has been increased from nothing to $30,000.

LIGHT, HEAT AND POWER.

Charters

Auburn, Schuylkill county: The Auburn Electric Light, Heat and Power Company, supplying electricity to the public at Auburn; capital, $15,000; treasurer, F. J. Voss, Auburn.

Harrisburg: New Ephrata Gas Company; manufacturing gas for light only for the public at Ephrata, Akron, Denver, Adamstown, Warwick, Lancaster county; capital, $5,000; treasurer, Guy H. Davies, Harrisburg.

General

Washington: The Canonsburg Electric Light, Heat and Power Company has increased its indebtedness from nothing to $43,000.

Ebensburg: The Ebensburg Light, Heat and Power Company has increased its capital stock from $50,000 to $100,000.

Benson: The capital stock of the White Oak Light, Heat and Power Company has been decreased from $20,000 to $2,000.

Reading: The following electric companies, of which George L. Roller, of this city, is treasurer, have been purchased by the Metropolitan Electric Company, of this city: Bern Township Electric Company, Colebrookville Township, Douglass Township, Earl Township, Exeter Township, Edison Electric Company of Boyertown, Edison Electric Company of Birdsboro, Edison Electric Company of Hamburg, Edison Electric Company of Heidelburg, Edison Electric Company of Pottstown, Edison Electric Company of Womelsdorf, Lower Alsace Township Electric Company, Lower Heidelburg Township, Upper Pottsgrove Township, Lower Pottsgrove Township, West Pottsgrove Township, Marion Township, Muhlenburg Township, Oley Township, Ontelannee Township, Perry Township, Robeson Township, Spring Township, Union Township, West Reading, Windson Township and the Wyomissing Electric companies.

Lebanon: The Edison Electric Illuminating Company of Lebanon has purchased the Mill Creek Township Electric Company, the West Lebanon and the Richland Electric Companies.

MISCELLANEOUS.

Special Feed Water Heater for Condensate and Returns, With Provision for Softening the Make-up Water: Where condensate from a surface condenser or returns from heating or drying systems form a considerable part of the boiler feed supply, it is often necessary to make up the full amount of feed water required by the boiler by adding water which is of a scale-forming or corrosive nature. On account of the disproportionately large cost of putting in a softening system of the usual type for this small amount of water it is usually fed to the boilers without treatment, with the result that scale is formed in the boilers. While the scale so formed is less than the amount that would be deposited if raw water alone were used for the boiler feed supply, the scale is, on the other hand, apt to be hard and, because of its slow formation, apt to be overlooked, resulting frequently in the unexpected burning of plates and tubes, leakage at seams and tube ends, etc. This problem has been attacked by the Harrison Safety Boiler Works, of Philadelphia, Pa., who in their recently published Engineering Leaflet No. 7, entitled "Combination Feed Water Heaters and Softening Systems," describe an apparatus designed for plants in which such conditions obtain. This apparatus differs from their Sorge-Cochrane Hot Process System in that provision is made for heating the two separate water supplies independently, and for treating only one with a reagent. The condenser discharge or other returns, after passing over heating trays, pass directly to the pump supply chamber or pure water compartment, whereas the raw water, after heating and mixing with the reagent, falls into a spacious sedimentation chamber and afterwards passes through a filter bed before entering the pure water compartment. To insure a continuous supply of water to the boilers in case of clogging of the filters, there is an automatic by-pass which, in case the level of the water in the pump supply chamber should fall below a certain level, will supplement with sufficient hot, treated water to supply the pumps. In a hot process system, the "temporary" hardness, or carbonates, are precipitated by heat, and the only reagent required is that needed for the transformation of "permanent" hardness, such as sulphates, chlorides, nitrates, acids, etc. Due to the use of only one reagent, the management of the apparatus is much simplified, no complicated chemical analyses being required, as where two reagents must be proportioned to the varying requirements of the water. The apparatus has the further advantage over a cold process system that it performs, in addition, the functions of the feed water heater which should be installed in any case. For this purpose, it can be adapted to any of the various forms assumed by open feed water heaters, that is, it can be used as heater and receiver in connection with an exhaust steam heating system, etc. This pamphlet should prove of interest to all engineers having to do with steam plants where scale-forming water is encountered.

Harrisburg: Bills will be introduced in the Legislature this Winter providing for the taxing of all real estate of public service corporations, for the right of third class cities to take from these corporations franchises by quo warranto proceedings when there have been violations of the city franchises and for the compulsion of telephone and telegraph companies to place their wires in conduits, either owned by the companies, themselves or by the municipalities. These bills will be backed up by the League of Third Class Cities.

RAILWAYS.

Charter

Philadelphia: In response to petitions from residents along the Bustleton and Somerton turnpikes, application will be made on January 27, at Harrisburg, for a charter for the North Eastern Street Railway Company. The directors of the new company will be George B. Atlee, Meyer Schamberg, Morris Ebert, William D. Allen, A. W. Morton, F. T. Thomas, and Wilson Woelpper. The company's object is to operate a line along the turnpikes from Frankford avenue to the Byberry and Bensalem turnpike and thence along the latter road to the Philadelphia county line. The terminus of the proposed line, Somerton, is seventeen miles from the city hall.

General

Phoenixville: The Phoenixville, Valley Forge and Strafford Electric Railway Company has recently made extensions to its line.

Wilkes-Barre: The Wilkes-Barre and West Side Street Railway Company has filed a statement with the Secretary of the Commonwealth of its intentions to extend its lines.

Erie: The East Erie Commercial Railroad is contemplating extensions to the road in the vicinity of this city.

Wilkes-Barre: The Wilkes-Barre and Luzerne Street Railway Company will make extensions to its lines in the spring.

Harrisburg: The Lehigh Valley Railroad Company has notified the State Railroad Commission that it will comply with the Commission's recommendation in the Coplay Cement Company case, which was to the effect that the railroad company amend its freight rates on coal in the vicinity of Allentown so that the rates should be uniform. The cement company charged discrimination and when the Railroad Commission recommended a change in rates, the railroad company notified it that it would not change them. The facts in the case were then certified to Attorney General Todd but before further action had occurred the railroad company agreed to comply with the recommendations.

SEWERAGE.

General

Cresson: Estimates are being prepared for the construction of a sewage system and water works at the State Sanatorium at Cresson. The State Sanatorium at Hamburg, Berks county, will also be equipped during the present year with a system of sanitary sewers.

Glassport, Allegheny county: The borough engineer is co-operating with the engineers of the adjoining towns of McKeesport, Port View, and Versailles in the matter of the construction of a comprehensive sewer system and a sewage disposal plant.

West Newton, Westmoreland county: This borough must build a sewage disposal plant to care for its sewage which is now poured into the Youghiogheny river just above the water works intake pipe of McKeesport. The engineers in charge of the work are Trimble and Miller, of Pittsburg.

Coudersport, Potter county: As the Allegheny river at this point is unpolluted this town will not be permitted to discharge its sewerage into the stream. A proposed sewage system has been devised and it was contemplated that the sewage could be turned into the river.

An approved filtration plant for the sewage must be constructed. J. M. Young, of New York, is the engineer in charge of the plans for this plant.

Towanda: Plans will be prepared during this year for the construction of a sewage disposal plant on the North Branch of the Susquehanna, which at this point is at present unpolluted.

Corry, Erie county: Corry will prepare plans for an additional sewerage system and a new sewerage disposal plant. These changes, it is contemplated, will be made during the present year.

Erie: Experiments are being conducted with the different methods of disposing of sewerage sludge and the city will submit its report of its findings to State Health Commissioner Samuel G. Dixon. Benjamin Briggs is the city engineer.

Clearfield: This town will take up the question of preparing comprehensive plans for a sanitary sewerage system and a sewerage disposal plant. This work will be done during the current year. E. W. Hess is the engineer in charge of the plans.

Ligonier: F. H. Shaw, of Lancaster, is preparing complete plans for a sewerage system and a sewerage disposal works for Ligonier.

Danville: This borough has employed Charles W. Collins, of Philadelphia, to make plans for an extensive sanitary sewerage system and to plan a works for the treatment of the sewage. Mr. Collins has performed a similar service for Bedford, Bedford county.

Pottstown, Montgomery county: This town is considering the employment of an expert to plan a sewerage disposal works and lay out a muncipal disposal system.

Carlisle: This borough will vote on a bond issue for the building of sewers and a sewage treatment plan. A special election will be held in the Spring. Engineer Bingham is in charge of the proposed plans.

Hershey, Dauphin county: H. M. Hershey, the chocolate manufacturer, realizing that a sewage treatment plant is needed here, is considering the best methods of treating the town's sewage.

Chambersburg: Charles F. Mebus has been engaged to draw detailed plans for a sewerage system for Chambersburg. This town is now engaged in building a gravity water system, John Birkinbine, of Philadelphia, being the engineer. The Cumberland Valley Railroad is considering the abolition of all grade crossings here and other improvements are contemplated this year. The natural location of the borough and its awakened progressive spirit indicates that it will become the most important center in the valley.

Harrisburg: The League of Third Class Cities of Pennsylvania will present a bill in the Legislature, providing that where cities are ordered by the State Health Department to construct sewage disposal plants, the State provide one-half of the sum of money needed for the construction work. The contention of the cities in the League is that each city in keeping its sewage out of the streams protects the health of all the other communities situated along the stream further down.

Philadelphia: A report upon the experiments in the disposal of sewage will be made shortly to the State Department of Health by the Director of the Department of Public Works of this city. Councils appropriated $10,000 to carry on the experiments this year in obedience to an act of Assembly which requires the city to make a report before January 1, 1912, upon such experiments and which also requires the city to begin work upon a sewage disposal plant by that time. The department has already complied with this last mandate, in that it has begun the actual disposal of sewage in a new plant constructed at Holmesburg. The report will be based upon the work done at this plant, and the work conducted at the old Spring Garden water works in Fairmount Park.

STREETS AND ROADS.

Awards

Carrol township, Washington county: State Highway Commissioner has awarded the contract for the construction of 4,400 feet of brick pavement in this township to Donald McNeal, of Pittsburg, at his bid of $20,517.67.

Harrisburg: The unusually low prices secured by this city for the paving to be done in 1911, as the result of competition between the Barber Asphalt Paving Company and the Central Construction and Supply Company will mean that additional paving, not contemplated when the general paving ordinance was drawn up last year, will be possible. Bids will shortly be asked for the extra work. The awards will be made so that the work can be started in the Spring.

WATER SUPPLY.

Permits

Koppel: The Water Supply Commission of Pennsylvania approved the application of the Koppel Water Company, for the supply of water to the public in Koppel, Big Beaver township, Beaver county.

Lebanon: The Water Commission has approved the application of the Lebanon Valley Consolidated Water Supply Company for the purchase by the company of the right and franchises of the North Annville Water Supply Company, South Annville Water Supply Company, North Cornwall Water Supply Company and Jonestown Water Supply Company.

Weavertown: The application of the Weavertown Water Company, for the supply of water to the public in the township of North Lebanon, Lebanon county, was held under advisement by the State Water Supply Commission.

Williamstown: A hearing has been held on the protest by the citizens of Williamstown against the inadequate service given by the Williams Valley Water Company, at which hearing both protestants and the water company were represented and heard. The Water Commission directed both the protestants and the water company to report to it weekly relative to the condition of the water supply at Williamstown, and in the event of the present conditions failing to be remedied, the matter will be referred to the Attorney General by the Commission for his action.

Tannery, Carbon county: The State Water Commission has approved the application of the Lehigh Valley Railroad Company for permission to construct a bridge and fill over the Lehigh river, near Tannery, Carbon county, the application being approved with certain conditions imposed by the Commission.

General

Blandenburg, Cambria county: The Blandenburg Water Company has just finished its new water works. A gravity system is used and the reservoir is in the mountains. No meters will be used here, but a fire service is intended and this will be installed during the coming Spring or Summer.

Weatherly, Carbon county: The Weatherly Water Company will furnish its patrons with an additional water supply this year.

Brockwayville, Jefferson county: The Brockway Crystal Water Company will extend its water works system during the year and will obtain an additional supply.

Charmichaels, Greene county: The borough is considering the construction of a water works system during the year and in order to make conditions about the borough more sanitary a sewage system will probably be constructed.

Huntingdon: The Pennsylvania Industrial Reform School here will make improvements in the Spring to its water works system. Murray Africa is the engineer.

Latrobe: The water supply of this town is drawn from the Loyalhanna which receives the sewage from several towns further up stream asd the water is now treated with a chemical. Plans are now under way for the construction of a filtration plant by the Latrobe Water Company.

Pittsburg: Morris Knowles, of this city, has been employed by an association of individuals, who are conducting a fight against the Springfield Consolidated Water Company's raise in water rates, to show why such a raise is exorbitant and uncalled for.

Easton: The Lehigh Water Company is considering ways and means of treating the water supply of this city. It is understood that an investigation has been made at the Jersey Water Company's plant, at Boonton, where 40,000,000 gallons of water are daily sterilized by use of a chemical.

Engineers' Society of Pennsylvania

THIRD SERIES. FEBRUARY, 1911 No. 2.

MONTHLY BULLETIN

PERSONAL NEWS

In this column is published each month personal news relating to members of the Society. The item of interest should be sent to the Secretary Editorial Staff, on or before the first day of each month. A member need not hesitate to give news about himself. Such co-operation is essential to the success of the Bulletin.

Mr. H. K. Thornton, Superintendent E. & A. division of Penna. Railroad Co., at New Castle, Pa., has been promoted to Superintendent of the Long Island Railroad.

GENERAL

The Venango Engineers' Club held a meeting at the City Hotel, Oil City, on Thursday, January 19th, at which Messrs. C. W. Leach and H. W. Claybaugh spoke on Bituminous Coal Deposits in Pennsylvania, followed by an open discussion.

The meeting was preceeded by a dinner which with the meeting was a decided success.

This Society was one of the first to express its sympathy and offer co-operation with the State wide movement for a federation of Engineers.

ENGINEERING WORK PROPOSED

In this column is published each month news relating to proposed engineering work in Pennsylvania, as far as such information is obtainable. This service will be useful to contractors and the trade in Builders' Supplies. The items of interest embrace engineering constructive work of all kinds and degrees of magnitude. Send in the notes to the Secretary Editorial Staff, on or before the first day of each month.

BRIDGES.

Permits

Harrisburg: The application for a bridge across the North Branch of the Susquehanna river, at Plymouth, Luzerne County, has been approved subject to certain conditions, by the Water Supply Commission.

The application of the Delaware, Lackawanna and Western Railroad Company, for permission to erect two bridges over Brodheads creek, near Analomink, Monroe county, has been approved subject to certain conditions.

Proposals

Scranton: Scranton is ready to invite bids for the erection of a $265,000 viaduct at Mulberry street, to be paid for jointly by the city, the Scranton Railway Company and the Delaware and Hudson Company.

General

Harrisburg: An amendment to the act empowering townships to construct bridges over streams was offered in the House of Representatives and provides that where the expense is so great that the townships could not reasonably be expected to construct the viaducts, the county commissioners of a county shall erect bridges over canals and railways crossed by main highways.

BUILDINGS.

Charters

Philadelphia: D. F. Keenan Company, conducting the business of general contractors and engineers; capital, $50,000; treasurer, F. T. Goodwin, 322 Arcade building, Philadelphia.

Harrisburg: Gettys & Gettys, Incorporated, builders; capital stock, $5,000; treasurer, M. H. Gettys, Harrisburg.

Allentown: Ochs Construction Company, engaging in a general contracting and construction business; capital, $50,000; treasurer, Katie S. Ochs, Allentown.

Philadelphia: Jacob Myers Sons Company, erecting and constructing buildings and other structures; capital, $5,000; treasurer, J. W. Myers, Bryn Mawr.

Harrisburg: Elder Real Estate Company, constructing houses and buildings; capital, $5,000; treasurer, John A. Marshall, Harrisburg.

General

Harrisburg: A bill to change the present law that requires moving picture theaters except in cities of the first and second class to have three parallel four-foot aisles has been introduced in the House by Frank Gray, of Philadelphia. The present regulations are objected to by exhibitors of motion pictures as practically prohibiting the use of narrow halls for their shows, twelve feet of the width being required for aisles no matter what is the width of the building. The amendment proposed by Mr. Gray proportions the width of the aisles to the number of seats in a row across the hall, as follows: Where the rows across the width of the building contain eight seats or less, one center aisle four feet wide; more than eight seats but less than twelve, a four foot center aisle and a two foot aisle at each side wall; twelve seats or more, but less than twenty, a four foot center aisle and a three foot side aisle at each side wall; twenty seats or more, a four foot center aisle and a four foot aisle at each side wall; or at least one four foot aisle for every twenty seats or part thereof.

Representative Sassaman, Berks, has introduced a similar bill, while Representative Smith, Philadelphia, has introduced measures providing for uniform laws in third class cities, boroughs and townships for moving picture theaters, and placing the same restrictions upon theaters there as now exist in first and second class cities.

INDUSTRIAL.

Charters

Philadelphia: Armat Knitting Mills, manufacturing hosiery and other articles; capital stock, $50,000; treasurer, William R. Clark, 109 North Water street, Philadelphia.

Philadelphia: Bonita Manufacturing Company, mechanical devices; capital, $10,000; treasurer, David L. Short, West Collingswood, New Jersey.

Carbondale: Falls Coal Company, mining coal; capital, $6,000; treasurer, L. A. Patterson, Carbondale.

Sunbury: J. and A. Moeschlin, Inc., manufacturing malt liquors; capital, $100,000; treasurer, E. A. Moeschlin, Sunbury.

Philadelphia: Pittsburgh and Susquehanna Coal Company, mining coal; capital, $5,000; treasurer, Louis Delmas, Philadelphia.

Pittsburg: West Penn Automobile Company, manufacturing automobiles; capital, $10,000; treasurer, H. J. Nesbit, 450 Fourth avenue, Pittsburg.

Pittsburg: The Republic Rubber Company of Pittsburg, manufacturing merchandise of rubber; capital, $20,000; treasurer, Millard Fisher, 55 Elm street, Pittsburg.

West Pittston: The Casarietti Confectionery Company; capital, $20,000; treasurer, Jay Fuller, Wilkes-Barre.

Pittsburg: A. M. Kinney Lumber Company, manufacturing lumber; Capital, $30,000; treasurer, A. M. Kinney, 1219 Park building, Pittsburg.

Cambridge Springs, Crawford county: Blystone Manufacturing Company, manufacturing tools, implements and machinery; capital, $10,000; treasurer, J. A. McNany.

Coatesville: Chester County Motor Company, manufacturing automobiles; capital stock, $35,000; treasurer, Charles Brinton, Timicula.

Wilkes-Barre: The Square Motor Car Company, manufacturing automobiles; capital, $25,000; treasurer, V. A. Hook, Dorranceton.

Kane, McKean county: Thissen Silk Manufacturing Company; capital, $30,000; treasurer, R. A. Hill, Kane.

Philadelphia: Joseph I. Meany & Company, Inc., manufacturing boots and shoes; capital, $20,000; treasurer, F. I. Meany, 1834 North Seventeenth street, Philadelphia.

Pittsburg: Pittsburg Photoplay Company, manufacturing moving picture films; capital, $15,000; treasurer, Albert Warner, 612 Fifth avenue Extension, Pittsburg.

Coatesville: Jacobs-Schupert United States Fire Box Company, manufacturing fire boxes of iron and steel; capital, $250,000; treasurer, Joseph Humpton, Coatesville.

Philadelphia: Temple Malleable Iron and Steel Company; capital, $10,000; treasurer, E. C. Donaghy, Primos, Delaware county.

Philadelphia: Vulcan Steel Cast Die Works, manufacturing dies; capital, $5,000; treasurer, E. C. Donaghy, Primos, Delaware county.

Pittsburg: A. J. Becker Company, manufacturing automobiles; capital, $5,000; treasurer, F. S. Deip, 5739 Center avenue, Pittsburg.

Pittsburg: East Liberty Auto Company, manufacturing automobiles; capital, $5,000; treasurer, J. J. Feicht, Carnegie.

Myersdale: Glade Valley Manufacturing and Power Company, manufacturing dynamos, motors and cars and manufacturing of steam and electric power; capital, $5,000; treasurer, E. A. F. Barnes, Bellevue.

Philadelphia: Willits-Carr Company, manufacturing stationery; capital, $20,000; treasurer, M. W. Boyer, 626 North Thirty-second street, Philadelphia.

Grove City, Mercer county: The Penn Gasoline Company, manufacturing gasoline; capital, $48,000; treasurer, E. J. Fithian, Grove City.

Easton: Bachman Lumber Company, manufacturing all kinds of lumber; capital, $5,000; treasurer, E. C. Bachman, 23 North Ninth street, Easton.

Scranton: Nicholson Lumber Company, Inc.; capital, $40,000; treasurer, E. L. Triel, Scranton.

Philadelphia: Quaker Lady Candy Company, manufacturing all kinds of confectionery; capital, $100,000; treasurer, John D. Kenderdine, Berwyn, Chester county.

Pittsburg: Pennsylvania Sales Corporation, manufacturing carriages and wagons; capital, $5,000; treasurer, E. F. Gerber, Pittsburg.

Lancaster: Schlotzbauer Baking Company, manufacturing confections and bread and cakes; capital, $60,000; treasurer, G. W. Lemaster, Lancaster.

Franklin: The Wilson Motor Starter Company, manufacturing automatic air compressors and pneumatic starters for internal combustion engines; capital, $30,000; treasurer, William McC. Wilson, Franklin.

Philadelphia: Crescent Spinning Mills, manufacturing yarns; capital, $20,000; treasurer, H. W. Grant, 4626 Green street, Germantown, Philadelphia.

Philadelphia: Eastern Supply Company, manufacturing iron and steel; Capital, $5,000; treasurer, Howard W. Middleton, 7443 Devon street, Mt. Airy.

Indiana: McGregor & Company, constructing lightning conductors; capital, $10,000; treasurer, H. A. Boggs, Indiana.

Pittsburg: The Youghiogheny and Ohio Coal Company of Pennsylvania, mining coal and other materials; capital, $100,000; treasurer, Charles Porter, 910 House Building, Pittsburg.

Chester: Chester Converting Company, manufacturing yarns and textile fabrics; capital, $25,000; treasurer, William H. Thatcher, Swarthmore.

Scranton: Hull Manufacturing Company, making mechanical devices of iron, brass or aluminum for automatic water feeders for steam boilers; capital, $10,000; treasurer, H. P. Davies, Scranton.

Clearfield-Osceola Coal Mining Company, capital, $20,000; treasurer, A. K. Wright, Clearfield.

Philadelphia: Delaware River Equipment Company, manufacturing railroad supplies; capital, $10,000; treasurer, Sydney Kenney, 1337 North Thirteenth street, Philadelphia.

Pittsburg: Hirsch Brothers Company, Inc., manufacturing condiments and food products; capital, $25,000; treasurer, J. K. Luck, Brookline Boulevard, Pittsburg.

Easton: Mountain Ice Company of Pennsylvania, manufacturing ice; capital, $10,000; treasurer, Chester Snyder, Easton.

Philadelphia: Champion Compound Company, manufacturing chemicals; capital, $5,000; treasurer, Charles S. Wood, Devon, Pennsylvania.

Hellam township, York county: The New Hellam Distilling Company, distilling spirits; capital, $30,000; treasurer, Jacob Beitzel, York.

Warren: The Schwartz Oil and Gas Company, mining oil and boring for gas; capital, $60,000; treasurer, Carl Schwartz, Warren.

Blaine, Luzerne county: The Healy Coal Company, mining coal and other minerals; capital, $60,000; treasurer, M. J. Colligan, Scranton.

Coraopolis: The Robinson Oil Company, refining oil; capital, $25,000; treasurer, O. D. Robinson, Coraopolis.

Pittsburg: Hum & Leatherman, Incorporated, manufacturing elecrical appliances, lightning rods, etc.; capital, $50,000; treasurer, W. H. Leatherman, 103 Market street, Pittsburg.

Williamsport: West Branch Box and Lumber Company; capital, $40,000; treasurer, R. C. Hartman, Williamsport.

Philadelphia: F. C. Grant Company, manufacturing of tile, hollow block, sewer pipe, etc.; capital, $15,000; treasurer, C. J. Lippincott, Germantown, Philadelphia.

Pittsburg: Keystone Bronze Company, manufacturing castings of bronze, brass, copper and aluminum; capital, $5,000; treasurer, John C. Craig, Pittsburg.

Philadelphia: Penn Worsted Company, manufacturing wool, cotton, silk and other fabrics of yarn; capital, $5,000; treasurer, Henry Frankenberg, Mt. Vernon, N. Y.

Philadelphia: The Climax Coal Company, mining coal; capital, $20,000; treasurer, Charles W. Mills, 400 Betz Building, Philadelphia.

Harrisburg: Eastern Wholesale Lumber Company, manufacturing lumber; capital, $10,000; treasurer, Samuel Wittemyer, Harrisburg.

Warren: Pennsylvania Railway Motor Company, manufacturing railway cars, engines, boilers and machinery; capital, $200,000; treasurer, R. N. Brown, Warren.

Houtzdale: The Henrietta Coal Company, Incorporated, mining bituminous coal; capital, $24,000; treasurer, Asa Spencer, Philipsburg.

Philadelphia: Keystone Enameling Company, manufacturing enamel and enameled articles; capital, $5,000; treasurer, M. A. Donnelly, 5166 Parkside avenue, Philadelphia.

General

Pittsburg: An increase in indebtedness has been authorized by the Naomi Coal Company, from $1,000,000 to $2,145,000.

Reading: The Kerner Manufactory has increased its indebtedness from nothing to $45,000.

Pittsburg: The Blake Crusher and Pulverizer Company has increased its stock from $10,000 to $50,000.

Bangor: The Sterling Silk Glove Company has increased its indebtedness from nothing to $30,000.

Planebrook: The Silica Stone Works Company has increased its indebtedness from nothing to $110,000.

Williamsport: An increase of the capital stock of the Automatic Pruner Company has been authorized from $10,000 to $30,000.

Philadelphia: The Manufacturer's Supplies Company has increased its capital from $25,000 to $100,000.

Philadelphia: The Caloris Company has increased its stock from $50,000 to $100,000.

Philadelphia: The Tioga Steel and Iron Company has increased its stock from $100,000 to $200,000.

Easton: An increase of capital stock from $10,000 to $20,000 has been authorized by the Easton Knitting Mills.

Mechanicsburg: The capital of The D. Wilcox Manufacturing Company has been increased from $150,000 to $250,000.

Wapwallopen: The Hollenback Telephone Company has increased its capital stock from $5,000 to $20,000.

Ebensburg: The Ebensburg Coal Company has voted an increase of stock from $5,000 to $700,000 and an increase of indebtedness from nothing to $750,000.

Chambersburg: The Chambersburg Ice and Coal Company has increased its stock from $30,000 to $60,000.

Allentown: An increase of capital from $60,000 to $150,000 has been authorized by the Southdown Knitting Company.

Scranton: The Mayfield Silk Company has increased its indebtedness from nothing to $40,000.

Chester: The Blair Silica Brick Company has increased its indebtedness from nothing to $75,000.

Lebanon: The Swatara Electric Light and Power Company has authorized an increase in its capital stock from nothing to $30,000.

Millersburg: The capital stock of the Millersburg Shoe Company has been increased from $10,000 to $35,000.

Lykens: The Lykens Knitting and Manufacturing Company has increased its stock from $20,000 to $40,000.

York: An increase of indebtedness from $15,000 to $33,500 has been voted for by the Pennsylvania Foundry Company.

Williamsport: Sweet's Steel Company has increased its capital from $200,000 to $600,000.

Connellsville: The Connellsville Iron Works Company has increased its indebtedness from nothing to $50,000.

Columbia: The Columbia Manufacturing Company has increased its indebtedness from nothing to $30,000.

Lebanon: South Mountain Lumber Company has authorized an increase of capital stock from $25,000 to $50,000.

Reading: The Montello Brick Company has increased its indebtedness from nothing to $500,000.

Pittsburg: The Bellefield Company has voted to increase its indebtedness from $400,000 to $710,000.

Columbia: An increase of indebtedness has been authorized by the Columbia Manufacturing Company from nothing to $30,000.

LIGHT, HEAT AND POWER.

Charters

East Greenville, Montgomery county: East Greenville Electric Light, Heat and Power Company, supplying light, heat and power; capital, $5,000; treasurer, L. Y. Meschter, East Greenville.

Caln township, Chester county: Caln Township Electric Company; capital, $195,000; treasurer, L. A. Gray, Colman; principal office at Coatesville.

Meadville: The Meadville Electric Light Company; capital, $6,000; treasurer, Charles Blystone, Meadville.

Philadelphia: Beaver Meadow Electric Company; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Coatesville: The Chester Valley Electric Company; capital, $5,000; treasurer, L. A. Gray, Colmar.

Sadsbury Township, Chester county: Sadsbury Township Electric Company; capital, $5,000; treasurer, L. A. Gray, Colmar; principal office at Coatesville.

Easton: The Electric Company of Glendon; capital, $5,000; treasurer, T. F. McPherson, Easton.

McKeesport: McKeesport Home Light Company; capital, $5,000; Henry Firestone, McKeesport.

Lansford, Carbon county: Gas Company of Lansford, manufacturing gas for light only; capital, $5,000; treasurer, George F. Drumheller, Lansford.

Philadelphia: Butler Township Power Company, supplying Butler township, Schuylkill county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Coal Township Electric Company; supplying Coal township, Northumberland county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Conygham Township Electric Company, Columbia county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Delano Township Electric Company, Schuylkill county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: East Union Township Electric Company, Schuylkill county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Fairview Township Electric Company, Luzerne county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Hanover Township Electric Company, Luzerne county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Mahonoy Township Electric Company, Schuylkill county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Mt. Carmel Township Electric Company, Northumberland county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Union Township Power Company, Schuylkill county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Wright Township Electric Company, Luzerne county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Wilkes-Barre Township Electric Company, Luzerne county; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: West Mahonoy Township Electric Company, Schuylkill county; capital stock, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

West Chester: East Bradford Light, Heat and Power Company; capital, $5,000; treasurer, B. W. Haines, West Chester.

Somerset: Somerset Citizens Gas Company; capital, $5,000; treasurer, Clarence L. Shaver, Somerset.

West Chester: West Goshen Light, Heat and Power Company; capital, $5,000; treasurer, B. W. Haines, West Chester.

Pottstown: Suburban Electric Company of Upper Pottsgrove; capital, $5,000; treasurer, Dr. W. J. Ashenfelter, Pottstown.

Pottstown: Suburban Electric Company of Lower Pottsgrove; capital, $5,000; treasurer, Dr. W. J. Ashenfelter, Pottstown.

Pottstown: Suburban Electric Company of West Pottsgrove; capital, $5,000; treasurer, Dr. W. J. Ashenfelter, Pottstown.

Philadelphia: Banks Township Electric Company; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Dorrance Township Electric Company; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Lehigh Township Electric Company; capital, $5,000; Calvin Pardee, Jr., Hazleton.

Philadelphia: Lausanne Township Electric Company; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Philadelphia: Packer Township Electric Company; capital, $5,000; treasurer, Calvin Pardee, Jr., Hazleton.

Pittsburg: Ohio Pyle Falls Electric Light, Heat and Power Company; capital, $5,000; treasurer, R. L. Orr, 117 Empire Building, Pittsburg.

General

Harrisburg: A bill granting the right of eminent domain to light, heat and power companies has been introduced in the legislature by Representative Mills, of Bradford.

New Castle: The City is considering the advisability of installing a municipal lighting plant.

MISCELLANEOUS.

Charter

Pittsburg: A charter has been received by the Pittsburg School of Automobile Engineering which will conduct a training school and manufacture automobiles and automobile appliances. The capital stock is $5,000 and the treasurer D. W. Tausig, 1222 Franklin street, N. S., Pittsburg.

General

Lock Haven: John Nolan, of Cambridge, Massachusetts, a city planning engineer, has been engaged by the Board of Trade and Civic Club of this town to prepare plans for the beautification of Lock Haven. Mr. Nolan recently completed plans for the improvement of Reading.

Harrisburg: Good roads will occupy much of the time of the legislators this spring. Senator Thompson's plan for a Highway Commission and $3,000,000 for highways, and Senator Sproul's measure providing a comprehensive scheme of road building that would cover a period of ten years, will both cause discussion.

Fairview: Morrow Brothers, of Baltimore, were the lowest bidders for the construction of State buildings at Fairview where a new State hospital for the criminal insane is being erected.

Harrisburg: The administration bill providing for the extension of the authority of the State Railroad Commission will shortly be presented. The new commission will consist of five members and will be known as the Pennsylvania Utilities Commission.

Erie: Senator Clark of this city has prepared a bill providing that all wires in third class cities and boroughs be placed under ground. The municipalities may condemn or purchase the conduits necessary.

New Castle: A committee of councils, with the fire chief, are investigating the merits of auto fire trucks, with the object of purchasing, if the same prove satisfactory.

RAILWAYS.

General

Wilkes-Barre: The Wilkes-Barre and Luzerne Street Railway Company will make an extension of its lines this spring.

Philadelphia: The Philadelphia and Garrettford Street Railway Company has decided to increase its capital from $72,000 to $600,000.

Reading: The Reading Transit Company has notified the Secretary of the Commonwealth that it desires to increase its capital stock from $250,000 to $500,000.

SEWERAGE.

General

Harrisburg: Under the provisions of a measure presented in the House by Representative Keister the State would be compelled to pay one-half the cost of constructing sanitary sewage disposal plants, ordered by the State Health Department.

Pittsburg: Some of the Allegheny county boroughs and townships have united for the establishment of sewage disposal plants. Tarentum, Brackenridge, Harrison and East Deer townships have united in one group; Parnassus, New Kensington and Arnold in a second, and Springdale and Cheswick in a third.

Harrisburg: The trustees of the Danville State Hospital for the Insane are directed, by a bill introduced in the House of Representatives by P. C. Newbaker, of Montour county, to connect the effluent of the sewage disposal plant with the sewer system of the borough of Danville. The sum of $7,000 is appropriated.

New Castle: Bids have been asked for the construction of the Loraine street and also Ray street sanitary sewers, approximate length 600 feet each.

STREETS AND ROADS.

General

Harrisburg: Among the numerous bills introduced in the Legislature regarding roads and highways is that of Representative Gibson, of Lycoming, and which provides that roads may be built by townships without the appointment of juries of view in cases where agreements are reached between the townships and the property owners affected. The bill relates especially to changes of existing roads.

Oil City: Plans are on foot for 24,000 yards of paving in this city.

New Castle: The city of New Castle proposes to issue bonds to the amount of $47,000 for repaving of several of the main streets.

WATER SUPPLY.

Permits

Ohio Pyle: The Water Supply Commission of Pennsylvania has approved the application for a charter for the Ohio Pyle Falls Development Company, at Ohio Pyle, Fayette county.

General

Akron: The city of Akron, Ohio, has entered suit against the Akron Water Works Company to throw said Company into the hands of a receiver on account of the failure to furnish an adequate and pure water supply. The firm of Chester & Fleming, Consulting Engineers, Pittsburg, Pennsylvania, have been employed by the Water Works Company as hydraulic experts in connection with the suit.

Marion Centre: The application for a charter of the Marion Centre Water Company, at Marion Centre, Indiana county, has been disapproved by the State Water Supply Commission.

Cementon: The application of the Lehigh Valley Railroad Company, for fill along the Lehigh river, at Cementon, Lehigh county, was approved in accordance with the recommendation of the engineer.

Armstrong county: The application of the Pittsburg and Shawmut Railroad Company for bridges and fills over and along the Allegheny river and Mahoning creek, in Armstrong county, was approved in accordance with the recommendations of the engineer.

Crawford county: The matter of the drainage of Pymatuning Swamp in Crawford county was held under advisement.

Shickshinny: A communication was received from the Shickshinny Water Company agreeing to extend their service as ordered by the Water Commission.

Cynwyd: A protest against the service of the Springfield Consolidated Water Company, made by the Union Fire Association of Lower Merion and by the Neighborhood Club of Bala and Cynwyd was referred to the Attorney General for such action as he deemed proper.

Harrisburg: Designed as a means of enabling boroughs to keep out of the clutches of water and of light company monopolies, Representative Kern, of Montgomery county, has introduced a bill in the House, giving two or more boroughs the right to unite in the construction and operation of water and light companies.

Engineers' Society of Pennsylvania

THIRD SERIES. MARCH, 1911 No. 3.

MONTHLY BULLETIN

ENGINEERING WORK PROPOSED

In this column is published each month news relating to proposed engineering work in Pennsylvania, as far as such information is obtainable. This service will be useful to contractors and the trade in Builders' Supplies. The items of interest embrace engineering constructive work of all kinds and degrees of magnitude. Send in the notes to the Secretary Editorial Staff, on or before the first day of each month.

BRIDGES.

Charters

Albion, Erie county: Rogers Brothers Company, manufacturing girders, trusses, columns, templets and other materials for use in bridges, buildings and other structures; capital, $150,000; treasurer, Charles A. Rogers, Albion.

BUILDINGS.

Charter

Philadelphia: George F. Pawling & Company, contractors for erecting structural iron and steel work for buildings and manufacturers of all materials used in connection therewith; capital, $25,000; treasurer, George F. Pawling, 2532 South Colorado street, Philadelphia.

Scranton: Capouse Warehouse Company, constructing warehouses; capital, $15,000; treasurer, M. F. Corcoran, Dunmore.

Philadelphia: Manufacturers' Realty Company, constructing manufacturing plants and other buildings; capital, $40,000; treasurer, Harris J. Cohn, Philadelphia.

INDUSTRIAL.

Charters

Philadelphia: Bernstein, Baun, Cravis & Company, manufacturing woolen goods and wearing apparel; capital, $250,000; treasurer, Morris Bernstein, 2117 North Nineteenth street, Philadelphia.

New Castle: New Castle Street Cleaner Company, manufacturing street cleaning machinery; capital, $20,000; treasurer, Ralph C. English, New Castle.

Philadelphia: The Whitehall Cement Manufacturing Company, quarrying lime and cement stone and manufacturing cements of all kinds; capital, $5,000; treasurer, Louis B. Rink, 407 West Price street, Philadelphia.

Philadelphia: The Ellis Tobacco Company, manufacturing tobacco, cigars and cigarettes; capital, $5,000; treasurer, John Davidson, Rutledge.

Burnham, Mifflin county: Logan & Company, Incorporated, manufacturing merchandise of every sort for household uses; capital, $10,000; treasurer, Frank G. Kennedy, Jr., Burnham.

Philadelphia: Pecora Paint Company, manufacturing paints, enamels and fillers for wood and iron; capital, $250,000; treasurer, S. B. Bowen, Jr., 6407 Wayne avenue, Philadelphia.

Altoona: The Savan Coal Company, mining bituminous coal; capital, $75,000; treasurer, William I. Dougherty, Altoona.

New Bethlehem, Clarion county: The Machine and Wire Glass Company, manufacturing glass in all forms, including rough and polished plate glass, skylight glass, fancy and figured glass, opalescent glass, window glass, ribbed glass, pressed and structural glass; capital, $10,000; treasurer, W. H. Kiener, New Bethlehem.

Pittsburg: The Pittsburg Cornice and Roofing Company, manufacturing sheet metal work; capital, $5,000; treasurer, Carl Haas, 445 Atlantic avenue, Pittsburg.

Pittsburg: Wilpur Oil Company, mining, drilling and operating for petroleum oil and gas; capital, $12,000; treasurer, N. B. Madden, 226 Eastnor avenue, Pittsburg.

Wilkes-Barre: Keystone Quarry Company of Wilkes-Barre, quarrying and manufacturing stone for buildings and road making; capital, $20,000; treasurer, Charles S. Miles, 80 East Jackson street, Wilkes-Barre.

Pittsburg: Shenango Manufacturing Company, manufacturing iron or steel and articles from either or both; capital, $5,000; treasurer, R. T. Rossell, 1027 Carnegie Building, Pittsburg.

New Castle: The Derby Hat Company, manufacturing hats and caps; capital, $5,000; treasurer, Mark L. Rabinovitz, New Castle.

Erie: Erie Butcher-Saw Company, manufacturing saws and blades for saws; capital, $12,000; treasurer, William C. Kraemer, 438 West Sixth street, Erie.

Philadelphia: Fulton Walker Company, manufacturing automobiles, wagons, trucks and cars; capital, $25,000; treasurer, J. Howard Wilson, 5537 Girard avenue, Philadelphia.

Akron, Lancaster county: Miller, Hess & Company, manufacturing boots and shoes; capital, $100,000; treasurer, A. M. Wolf, Akron.

Pittsburg: Pittsburg Crucible Steel Company, manufacturing iron and steel; capital, $5,000; treasurer, J. S. Swearer, 1027 Carnegie Building, Pittsburg.

Pittsburg: Universal Fuel Sales Company, mining coal and other minerals; capital, $100,000; treasurer, R. F. Meyers, Oliver Building, Pittsburg.

Philadelphia: Wohlfeld Trunk and Bag Company, manufacturing automobile luggage, trunks, suit cases and pocketbooks; capital, $40,000; treasurer, George B. Pfingst, Oak Lane and Tenth street, Philadelphia.

Philadelphia: American Art Marble Company, manufacturing artificial marble and contracting for buildings in which marble is used; capital, $250,000; treasurer, H. G. Stephens, Llanerch.

Warren: Barnhart-Davis Company, manufacturing mechanical apparatus, machinery and castings from iron, steel, brass or other metal and conducting a general foundry and machine shop; capital, $40,000; treasurer, Charles R. Henry, Warren.

Philadelphia: Concrete Waterproof Paint Company of America, manufacturing paints, varnishes, stains and enamels; capital, $25,000; treasurer, Jacob G. Binswanger, 1619 North Sixteenth street, Philadelphia.

Philadelphia: Penn Couch Bottom Company, manufacturing couch bottoms, beds, springs, wire and fabrics composed of iron or steel; capital, $5,000; treasurer, Seymour Siegman, 714 Spruce street, Philadelphia.

Athens, Bradford county: The Rift Climbing Boat Company, manufacturing boats and boat parts; capital, $30,000; treasurer, Charles E. Mills, Athens.

Punxsutawney: Hamilton Coal Company, mining coal and manufacturing coke; capital, $10,000; treasurer, W. L. Simpson, Punxsutawney.

Shillington, Berks county: Althouse Stone Company, manufacturing stone for building and paving purposes; capital, $5,600; treasurer, Cyrus D. Althouse, Shillington.

Philadelphia: Lykens Valley Products Company, manufacturing lumber, planting and cutting trees; capital, $5,000; treasurer, George B. Wells, Philadelphia.

Green Lane, Montgomery county: The Perkiomen Valley Brewing Company, manufacturing malt liquors; capital, $30,000; treasurer, H. T. Bechtel, Green Lane.

Philadelphia: Valkone Dye and Finishing Works, manufacturing and dyeing woolens, worsted and mixed textile fabrics; capital, $40,000; treasurer, Thomas D. Sullivan, 1913 Spring Garden street, Philadelphia.

Philadelphia: The F. C. Grant Company, manufacturing chemical wares, brick, tile, hollow blocks of shale, clay, lime and sand; capital, $15,000; treasurer, C. J. Lippincott, 152 Belmar Morris Apartment, Germantown, Philadelphia.

Pittsburg: Keystone Bronze Company, manufacturing castings of bronze, copper, brass and aluminum; capital, $5,000; treasurer, John S. Craig, Pittsburg.

Philadelphia: Penn Worsted Company, manufacturing worsted, wool, cotton and silk fabrics; capital, $5,000; treasurer, Henry Frankenberg, Mount Vernon, N. Y.

Punxsutawney: Summit Coal Mining Company, mining coal, iron ore, limestone and fire clay; capital, $100,000; treasurer, Eugene H. Winslow, Punxsutawney.

Saltsburg: Patterson Milling Company, manufacturing wheat, rye, oats and buckwheat into flour; capital, $30,000; treasurer, H. C. W. Patterson, Saltzburg.

Philadelphia: Harvey Fibre Carpet Company, manufacturing carpets and fabrics of yarn; capital, $200,000; treasurer, Joseph C. Harvey, 1232 West Venango street, Philadelphia.

Pittsburg: Crucible Coal Company, mining coal and manufacturing coke; capital, $5,000; treasurer, J .C Swearer, 1027 Carnegie Building, Pittsburg.

Kittanning: The Fort Pitt Powder Company, manufacturing blasting, mining and sporting powders, dynamite and nitroglycerine compounds, fuse blasting caps, fuses and blasting batteries; capital, $100,000; treasurer, H. G. Gates, Kittanning.

Philadelphia: Shepherd Manufacturing Company, manufacturing woolen, worsted and cotton fabrics; capital, $10,000; treasurer, Gwynn T. Shepperd, 3200 Arch street, Philadelphia.

Connellsville, Fayette county: Zough Distilling Company; capital, $50,000; treasurer, Owen Murphy, Latrobe.

Homer City: Homer City Ice Company, manufacturing ice; capital, $12,000; treasurer, C. A. Simons, Blairsville.

Danville: Nam-trach Knitting and Spinning Company, manufacturing, knitting and spinning all kinds of textile work; capital, $40,000; treasurer, F. Q. Hartman, Danville.

Pittsburg: Pitt Motor Sales Company, manufacturing motor propelled vehicles for land, water or air; capital, $10,000; treasurer, Percy T. Coburn, 726 Whitney avenue, Wilkinsburg.

Pittsburg: West Liberty Lumber Company, manufacturing lumber and builders' supplies; capital, $5,000; treasurer, W. G. Rebbeck, Pittsburg.

Rochester: Beaver Brewing Company, manufacturing and brewing malt liquors; capital, $5,000; treasurer, S. Horwitz, Pittsburg.

Philadelphia: Fischer Motor Car Company, manufacturing motor cars; capital, $10,000; treasurer, Miss Elma Dyson, Ardmore.

Philadelphia: Ideal Art Needlework Company, manufacturing art needlework and novelties; capital, $20,000; treasurer, James White, 639 North Fortieth street, Philadelphia.

Philadelphia: Sacks Bros., manufacturing cloaks and suits; capital, $200,000; treasurer, Harry Sacks, 1220 Cherry street, Philadelphia.

Bangor: The Bangorvein Slate Company, quarrying and mining slate and slate products; capital, $5,000; treasurer, M. J. Spry, Bangor.

Philadelphia: Haines Leather Goods Company, manufacturing leather goods; capital, $25,000; treasurer, J. Harrison Hill, Huntingdon Valley, Montgomery county.

Homestead, Allegheny county: The Homestead Paint and Glass Company, manufacturing paint, glass and builders' supplies; capital, $10,000; treasurer, W. K. Vansciver, Homestead.

Peckville, Lackawanna county: Peckville Silk Company, manufacturing silk thread and cloth; capital, $25,000; treasurer, W. H. Kilgour, 1011 North Main avenue, Scranton.

Uniontown, Fayette county: Producers' Coke Company, mining coal and manufacturing coke and by-products; capital, $50,000; treasurer, Harold W. Semans, Uniontown.

Scranton: The A. E. Rogers Company, manufacturing jewelry; capital, $100,000; treasurer, J. W. McAnvic, Scranton.

Philadelphia: Keystone Negative Company, manufacturing moving picture films; capital, $5,000; treasurer, Lemuel Sichels, 1615 South Fifteenth street, Philadelphia.

Philadelphia: Macbeth Arc Lamp Company, manufacturing lamps of all kinds; capital, $12,000; treasurer, Norman Macbeth, 3104 Midvale avenue, Philadelphia.

Philadelphia: Printers' Machinery Company of Pennsylvania, manufacturing machinery for printers; capital, $10,000; treasurer, William Fullard, 243 West Union street, Burlington, N. J.

Philadelphia: Wolberg-Robinson Metal Company, smelting and refining all sorts of new and old metals; capital, $10,000; treasurer, Louis C. Robinson, 641 South Fifty-second street, Philadelphia.

Harrisburg: Union Planing Mill Company of Harrisburg, manufacturing all forms of lumber; capital, $6,000; treasurer, Charles B. Langletz, Harrisburg.

McKeesport: The Thomas Moore Distilling Company; capital, $300,000; treasurer, Albert S. Gaus, 5626 Margaretta street, Pittsburg.

Philadelphia: Progressive Knitting Mills Company, manufacturing knit underwear; capital, $25,000; treasurer, John Lindauer, Jr., 736 North Twentieth street, Philadelphia.

Pittsburg: Reliance Heating Company, installing heating and ventilating systems; capital, $5,000; treasurer, W. A. Rodahaver, 7588 Kelly street, Pittsburg.

Mars, Butler county: The Mars Land and Lumber Company, manufacturing lumber; capital, $50,000; treasurer, J. S. Clark, Mars.

General

Columbia: The Columbia Manufacturing Company has increased its indebtedness from nothing to $30,000.

Kirkwood: The board of directors of the Southern Telephone and Telegraph Company has increased the company's capital stock from $35,000 to $100,000.

Pittsburg: An increase in indebtedness from nothing to $150,000 has been ordered by the Scott Iron and Steel Company of this city.

Ambler: An increase in the capital stock of the Cruse-Kemper Manufacturing Company has been voted upon by the company's directors. The stock will be increased from $150,000 to $500,000.

Greensburg: The Keystone Coal and Coke Company has increased its indebtedness from $2,500,000 to $6,000,000.

Pittsburg: The Blake Crusher and Pulverizer Company has increased its capital stock from $10,000 to $50,000.

Bangor: The Sterling Silk Glove Company has ordered an increase of indebtedness from nothing to $30,000.

Planebrook: An increase in indebtedness from nothing to $110,000 has been authorized by the directors of the Silica Stone Works of this place.

Williamsport: The directors of the Automatic Pruner Company have decided to increase the capital stock from $10,000 to $30,000.

Philadelphia: An increase of capital from $25,000 to $100,000 has been voted upon by the Manufacturers' Supplies Company.

Philadelphia: The Caloris Company has increased its capital from $50,000 to $100,000.

Philadelphia: An increase in capital from $100,000 to $200,000 has been decided upon by the Tioga Steel and Iron Company.

Easton: The Easton Knitting Mills Company has voted to increase its capital stock from $10,000 to $20,000.

Mechanicsburg: The D. Wilcox Manufacturing Company of this borough has increased its capitalization from $150,000 to $250,000.

Wapwallopen: The Hollenback Telephone Company has increased its capital stock $15,000, from $5,000 to $20,000.

Williamsport: The Sweets Steel Company has increased its capital stock from $200,000 to $600,000.

Connellsville: An increase of indebtedness from nothing to $50,000 has been decided upon by the Connellsville Iron Works Company.

Philadelphia: The Keystone Supply and Manufacturing Company has increased its indebtedness from $40,000 to $85,000.

Wilkes-Barre: The directors of the Summit Coal and Iron Company have increased the indebtedness of the company from nothing to $200,000.

Blairsville: The Blairsville Ice Company has decided to increase its capital stock from $6,000 to $12,000.

Philadelphia: An increase in capital stock from $10,000 to $35,000 has been decided upon by the board of directors of the National Novelty Company.

Pittsburg: The Kendall Coal and Coke Company has increased its stock from $16,000 to $60,000.

Pittsburg: Pittsburg Crucible Steel Company has increased its indebtedness from nothing to $7,500,000.

Greensburg: The L. E. Smith Glass Company has increased its indebtedness from nothing to $10,000.

Greensburg: The Keystone Coal and Coke Company has increased its indebtedness from $2,500,000 to $5,000,000.

North Huntingdon township, Westmoreland county: The Jersey Cereal Company has authorized an increase in its capital stock from $200,000 to $500,000.

Pittsburg: The Pittsburg High Voltage Insulator Company has increased its stock from $100,000 to $400,000.

Allentown: The board of directors of the Allentown Paving Brick Company has increased the company's indebtedness from $25,000 to $100,000.

Philadelphia: The capital stock of the Reyburn Manufacturing Company has been increased from $100,000 to $200,000.

Pittsburg: The East End Mantel and Tile Company has increased its indebtedness from nothing to $21,125.

Philadelphia: The Penn Surgical Manufacturing Company has increased its capital stock from $15,000 to $50,000.

Scranton: The Hudson Coal Company has decided to increase its capital stock from $100,000 to $2,500,000 and has so notified the State Department.

Easton: The directors of the Victor Balata and Textile Belting Company have voted to increase the capital stock of the company from $24,000 to $100,000.

Bath: The Pennsylvania Cement Company has increased its capital from $500,000 to $860,000.

Pittsburg: An increase in indebtedness has been voted upon by the L. H. Smith Woodenware Company and it will be changed from $55,000 to $72,500.

Pittsburg: The capital stock of the Harris Pump and Supply Company has been increased from $60,000 to $80,000.

Philadelphia: The Seaboard Coal and Coke Company has increased its indebtedness from nothing to $1,000,000.

LIGHT, HEAT AND POWER.

Charters

Allentown: Application will be made to Governor Tener on April 3 by W. A. Lathrop, Rollin H. Wilbur and H. F. Baker, of Philadelphia, for about sixty charters for electric light and power companies in Lehigh, Schuylkill, Carbon, Northampton, Bucks and Montgomery counties. This is the first step in the scheme of the Lehigh Coal and Navigation Company, which has plans to electrify Eastern Pennsylvania, affecting a territory with a population of 2,500,000. It is the plan to organize a separate electric company in each of the townships of these counties. In Lehigh county there will be the Hazard Electric Company, for Hanover; Oakdale Electric Company, for Salisbury; the South Whitehall Electric Company, for South Whitehall; the Equitable Electric Company, for Whitehall; the North Whitehall Electric Company, for North Whitehall; the Diamond Electric Company, for Washington; the Upper Macungie Electric Company, for Upper Macungie, and the Upper Milford Electric Company, for Upper Milford

During the past month the following charters for electric companies have been issued throughout the State:

York: Hellam Township Light, Heat and Power Company, furnishing light, heat and power to the public in Hellam township, York county; capital, $5,000; treasurer, Charles A. Greenawalt, York.

York: Springgarden Township Light, Heat and Power Company; capital, $5,000; treasurer, Charles A. Greenawalt, York.

Kulpsville, Montgomery county: Towamencin Electric Company; capital, $5,000; treasurer, Joseph Becker, Kulpsville.

Westmont, Cambria county: Upper Yoker Light, Heat and Power Company; capital, $5,000; treasurer, C. G. Campbell, Johnstown.

Titusville: Titusville Light and Power Company; capital, $5,000; treasurer, William J. Seltzer, Philadelphia.

General

Lebanon: The Mt. Gretna Light and Power Company has increased its capital stock from $5,000 to $25,000.

Wilkes-Barre: An increase in capital from $5,000 to $100,000 has been authorized by the Wilkes-Barre Light Company.

Clearfield: The Greene Heat, Light and Power Company has increased its capital stock from $10,000 to $15,000.

Pittsburg: The Allegheny Valley Light Company has increased its capital from $150,000 to $250,000.

Philadelphia: The Chester Valley Electric Company, through its directors, has increased its capital stock from nothing to $750,000.

Strasburg: An increase in the capital of the Strasburg Light, Heat and Power Company has been directed by the company from $50,000 to $85,000.

Wilkes-Barre: The Wilkes-Barre Light Company has increased its indebtedness from nothing to $100,000.

Marianna, Washington county: Marianna Light, Heat and Power Company; capital, $10,000; treasurer, J. E. Lynch, Pittsburg.

Ephrata, Lancaster county: New Ephrata Fuel Gas Company, manufacturing gas for fuel for Ephrata, Akron, Denver, Adamstown, Warwick and in Ephrata, Warwick, East Cocalico, Earl, East Earl and Donegal townships, Lancaster county; capital, $5,000; treasurer, Guy H. Davies, Harrisburg.

Portland, Northampton county: Portland Power Company; capital, $5,000; treasurer, James A. McNelus, 404 Sixth avenue, Brooklyn.

Ferndale, Cambria county: Bens Creek Light, Heat and Power Company; capital, $5,000; treasurer, C. G. Campbell, 445 Somerset street, Johnstown.

Franklin, Cambria county: Cambria Light, Heat and Power Company; capital, $5,000; treasurer, C. G. Campbell, Johnstown.

Dale, Cambria county: Stoneycreek Light, Heat and Power Company; capital, $5,000; treasurer, C. G. Campbell, Johnstown.

Harrisburg: J. H. Anderson, of Luzerne, has introduced a bill in the Legislature to validate certain electric light company charters. A preamble states that "prior to 1903, upon a broad construction of the word 'district,' contained in the thirty-fourth section of the act approved April 29th, 1874, * * * the Governor of the Commonwealth issued letters patent or charters incorporating a number of electric light companies for the purpose of supplying electricity for heat, light and power in districts comprising contiguous municipalities or townships," and that some of these companies have established plants and are supplying electricity. To remove any doubt as to the validity of such charters, the act proceeds to declare them valid where the companies have gone ahead and erected plants and are supplying light, heat or power.

MISCELLANEOUS.

Harrisburg: A bill has been introduced in the Senate by D. A. Wilbert, Allegheny county, authorizing municipalities to purchase or condemn and to maintain and operate street railways, electric light plants, gas works and all other public utilities. Senator Wilbert also has introduced a measure authorizing municipalities to provide a supply of water for municipal and domestic use.

RAILWAYS.

Charters

Bangor: A charter has been issued to the Water Gap and Portland Street Railway Company. The capital stock of the company is $24,000.

General

Pittsburg: The Ben Avon and Emsworth Street Railway Company will make extension of its route this spring.

Philadelphia: Extensions of route will be made by the Trenton, Bristol and Philadelphia Street Railway Company.

Sunbury: Extensions are planned by the Sunbury and Northumberland Electric Railway Company, the proposed extensions being three miles in length.

Wilkes-Barre: The Wilkes-Barre and Luzerne Street Railway Company will make extensions to its lines this spring.

Pittsburg: The articles of association for the Pittsburg, Butler, Slippery Rock, Grove City and Northern Street Railway Company have been approved by Governor Tener.

Reading: The capital of the Reading Transit Company has been increased from $500,000 to $5,000,000.

Meadville: The Northwestern Pennsylvania Railroad Company has increased its capital stock from $1,000,000 to $1,500,000. This company has just merged with the Crawford and Erie Railroad Company.

Pittsburg: The Pittsburg, Neville Island and Coraopolis Railway Company has filed at the State Department its intention to extend its route two and a half miles.

Philadelphia: The Terminal Railway Company will extend its route this spring on Penn Boulevard, Upper Darby township, Delaware county.

STREETS AND ROADS.

General

Harrisburg: The Sproul good roads bill, providing for a comprehensive system of State highways, comprising 203 routes and connecting every important center of population in Pennsylvania, has been introduced in the State Senate. A bill making possible the floating of a $50,000,000 loan for roads accompanied it.

Harrisburg: This city this spring and summer will lay 300,000 square yards of asphalt.

SEWERAGE.

General

Carlisle: The people of this borough at a special election in February voted to construct a comprehensive sewage system and Coakley Hatton, an engineer of Wilmington, Del., has been engaged to draw plans. The work will be carried on this summer.

West Chester: The borough of West Chester will construct two sewage disposal plants this summer; one of these will take care of the sewage that comes down the Goose Creek valley and the other that which is drained through the Taylor's Run valley. Abbott Daimon, of Derby, is the engineer.

Schuylkill Haven: The county commissioners of Schuylkill county have decided to erect a sewage disposal plant at the county home at this place.

Chambersburg: Charles F. Mebus, engineer, of Philadelphia, has submitted plans for the new sewage disposal plant for this borough and they have been approved. The work will start this spring.

Erie: City Engineer Benjamin B. Briggs, of this city, is laying out a sewage testing station.

McKeesport: Radical changes to the sewage system of this place and adjoining municipalities are contemplated and City Engineer Smith, of McKeesport, has associated with him Leo Hudson, of Haverstraw, N. Y., to work out an improved system for the sewage collection and for sewage disposal plants.

Valley Camp, Westmoreland county: Valley Camp will construct a sewage disposal plant this summer and plans are now being prepared by Chester and Fleming, of Pittsburg.

Harrisburg: Many miles of lateral sewers and a $316,000 river front intercepting sewer will be built this summer.

Monongahela: The Liggett Spring and Axle Company, of Monongahela, Pa., has employed the firm of Chester & Fleming, Engineers, Pittsburg, Pa., to install a sewage disposal plant for the Company's works and houses at Monongahela, Pa.

WATER SUPPLY.

Permits

Walnut Grove: The Pennsylvania State Water Supply Commission at its last meeting approved the application of the Walnut Grove Water Company.

Kiskiminetas Junction: A permit has been granted by the State Water Commission to the Pennsylvania Railroad for an extension to the southeast bank of the Kiskimetas river, two miles east of Kiskimetas Junction, Allegheny township, Westmoreland county.

York: The Edison Electric Company of this city has been granted its application to construct a wooden crib in the Codorus creek at York.

Vandergrift: The application of the Pennsylvania Railroad for the making of an extension to the southeast bank of the Kiskimetas river, at a point 5,847 feet west of Vandergrift passenger station, Westmoreland county, was held under advisement.

Dickerson Run: The State Water Supply Commission has returned for amendment the application of the Dickerson Run Water Company for incorporation.

General

Harrisburg: The State Water Supply Commission has expressed to representatives of the Pittsburg Flood Commission their desire to co-operate with the United States government in securing tracts of land to add to the Appalachian reserve. The commission was represented by W. M. Jacoby, E. K. Morse and others, of Pittsburg.

who urge that a bill be presented to give the Federal government right to purchase.

The commissioners were favorable and urged that in selection of tracts the government co-operate with the State Forestry Department and the Water Supply Commission, which have been engaged in systematic study of conservation and flood problems.

New Kensington: Chester & Fleming, engineers, of Pittsburg, have been retained by the Kensington Water Company to prepare plans for filters for the towns of Arnold, New Kensington and Parnassus.

Parker City: The Parker City Water Company has retained Morris Knowles, of Pittsburg, to prepare plans and specifications for a water filter plant.

Erie: The Board of Water Commissioners of Erie, William Hamilton, president, have engaged Prof. W. T. Mason, Troy, N. Y.; Prof. E. T. Smith, Beloit, Wisconsin, and Prof. W. F. Westbrook, of the University of Minnesota, to make a report relative to improving the water works system of Erie, including the purification of the supply for the city.

Altoona: The Roselawn Water Company has increased its indebtedness from nothing to $25,000.

Corry: The board of directors of the Corry Water Company has increased the capital stock for the company from $50,000 to $100,000.

Houtzdale: The Ramey Water Company has increased its capital stock from $5,000 to $20,000.

Matamoras: The Matamoras Citizens' Water Company has increased its indebtedness from $23,100 to $38,100.

Wells Falls: Senator Buckman, of Bucks county, has introduced a bill in the Senate to authorize the Union Mills Paper Manufacturing Company to maintain and operate a dam in the Delaware river at this point.

East Liverpool, Ohio, has employed the firm of Chester & Fleming, Engineers, Pittsburg, Pa., in connection with the proposed improvements to the water system and the installation of a new pumping station.

Clarion: The Clarion Water Company has employed the firm of Chester & Fleming, Engineers, Pittsburg, Pa., to design and install a water filtration plant.

Bellevue: The Ohio Valley Water Company has employed the firm of Chester & Fleming, Engineers, Pittsburg, Pa., to install additional drilled wells for the water supply on Neville Island.

Valley Camp: The contract for constructing the sewage disposal plant for Valley Camp, Westmoreland County, Pennsylvania, has been awarded to the Pitt Construction Company, Pittsburg, Pa., and work will begun within ten (10) days. Chester & Fleming, Engineers, Union Bank Building, Pittsburg, have charge of the work.

Engineers' Society of Pennsylvania

THIRD SERIES. APRIL, 1911 No. 4.

MONTHLY BULLETIN

ENGINEERING WORK PROPOSED

In this column is published each month news relating to proposed engineering work in Pennsylvania, as far as such information is obtainable. This service will be useful to contractors and the trade in Builders' Supplies. The items of interest embrace engineering constructive work of all kinds and degrees of magnitude. Send in the notes to the Secretary Editorial Staff, on or before the first day of each month.

WATER SUPPLY.

General

North Manheim, Schuylkill county: The North Manheim Water Company has been permitted by the State Health Department to take its water from Tumbling river, but the water must be filtered. This company is a subsidiary of the Philadelphia and Reading Coal and Iron Company.

Schuylkill Haven: The Schuylkill Haven Gas and Water Company will obtain an additional source of supply from Hummel's Run and Borgenbach's Run and will construct intake dams, gravity pipe lines and make other improvements. The borough superintendent is in charge of the work.

Conneaut Lake, Crawford county: Conneaut Lake is building a municipal water works system, the work just now nearing completion. The work consisted of driven wells, a pumping station, the construction of a tank and distributing pipes. This work will probably be followed by the building of a comprehensive sewage system.

Springdale, Allegheny county: This town is considering the construction of a municipal water works, consisting of drilled wells, a pumping station, storage reservoir and gravity pipes. Douglass & McKnight, of Pittsburg, are the engineers in charge of the proposed work.

Ligonier, Westmoreland county: A municipal election will be held on the proposition to extend the water works system of this borough. It is proposed to extend the water works system of this borough It is proposed to construct impounding reservoirs, distributing reservoirs and gravity mains. H. F. Shaw, of Lancaster, has been engaged as the engineer.

Akron, Lancaster county: This borough will install a municipal system of water works this spring. The work will include drilled wells, a pumping station, receiving basin, standpipe and distributing pipes. Horatio Sands is the engineer in charge.

Oakmont, Allegheny county: The Suburban Water Company has submitted plans to the State Health Department for a mechanical filtration plant and these have been improved. The work will start early this spring. Morris Knowles, of Pittsburg, is the engineer.

Parker, Armstrong county: The Parker City Water Company has been required by the State officials to install a municipal water filter plant. Plans are being prepared by Morris Knowles, of Pittsburg.

Saegerstown, Crawford county: This borough has decided to construct a municipal water works system this season. This will consist of driven wells, a pumping station, distributing reservoir and street mains.

Rheems, Lancaster county: The village of Rheems, West Donegal, Lancaster county, will build additional wells, make extensions to its pipe system and make other improvemente this spring.

Pleasant Gap, Centre county: The Pleasant Gap Water Supply Company will construct a water works system, consisting of connecting mountain springs with a distributing reservoir, the construction of pipe lines and fire hydrants.

BUILDINGS.

Charter

Brookville, Jefferson county: The Central Constructing Company, constructing buildings, reservoirs, conduits, wells, canals, roads, bridges, and so on; capital, $40,000; treasurer, F. W. Edmonson, Brookville.

Homestead: Murray-Cosgrove Company, general contractors; capital $5,000; treasurer, William J. Cosgrove, Munhall.

Philadelphia: Morris Realty Company, constructing buildings; capital, $5,000; treasurer, Edward Hutchison, Jr., 2809 Queen Lane, Philadelphia.

Reading: The Casino Pavilion Company, constructing park buildings, capital, $5,000; treasurer, W. A. Sharp, Reading.

Pittsburg: Franklin Building Company, constructing all kinds of buildings; capital, $5,000; treasurer, James F. McNaul, Commonwealth Building, Pittsburg.

Pittsburg: Pittsburg Building and Supply Company, constructing buildings and other structures; capital, $20,000; treasurer, Morris Aronson, 5611 Rural avenue, Pittsburg.

Cornog Station, Chester county: Cornog Trap Rock Construction Company, constructing buildings and roads; capital, $18,000; treasurer, George W. Stine, East Downingtown.

INDUSTRIAL.

Charters

Slatington: Bluevein Slate Company, mining and manufacturing slate by-products, capital, $20,000; treasurer, A. S. Haines, Slatington.

Philadelphia: Shriner, McGlynn & Company, incorporated, manufacturing sheets, rods, wire and other articles rolled, cast or stamped from metal; capital, $25,000; treasurer, C. E. L. Hatch, Hamilton Court, 39th and Chestnut streets, Philadelphia.

Philadelphia: The Tabor Manufacturing Company, manufacturing machinery; capital, $10,000; treasurer, Wilfred Lewis, 5901 Drexel Road, Philadelphia.

Pittsburg: Morrison Photo Supply Company, manufacturing draughtsmen's and photographic supplies; capital, $10,000; treasurer W. Howard Morrison, Emsworth.

Philadelphia: Revere Paint Company, manufacturing paints, varnishes, oils, fillers, stains, colors, enamels and waterproof coatings; capital, $5,000; treasurer, Ernest W. Haldt, 6142 Morton street, Philadelphia.

Philadelphia:. McCloskey Varnish Company; manufacturing varnish and ornamental and preservative coatings; capital, $100,000; treasurer, George B. Heckel, 4032 Chestnut street, Philadelphia.

North Braddock, Allegheny county: Braddock Stone and Contracting Company, quarrying and manufacturing stone and stone products and conducting the business of general contractors; capital, $10,000; treasurer, John F. McCune, North Braddock.

McKeesport: E. S. Shupe Company, manufacturing grocery specialties; capital, $5,000; treasurer, Edward S. Shupe, McKeesport.

Newmanstown, Lebanon county: Ibach Chemical Company, manufacturing pharmaceutical compounds; capital, $5,000; treasurer, John L. Shultz, Newmanstown, Lebanon county.

Pittsburg: Kennywood Scenic Railway Company, manufacturing scenic railways; capital, $20,000; treasurer, F. W. Henninger, Hytton avenue, Pittsburg.

Nazareth: Nazareth Planing Mill Company, manufacturing builders' supplies; capital, $50,000; treasurer, D. M. Leopold, Nazareth.

Pittsburg: Pittsburg Mop, Cordage & Supply Company, manufacturing of wooden and willow ware, hardware specialties, cordage, twine and mops; capital, $5,000; treasurer, E. C. Edmundson, McKeesport.

Philadelphia: Prescott Adamson, incorporated, manufacturing automobiles, automobile parts and accessories; capital, $10,000; treasurer, Prescott Adamson, Philadelphia.

Philadelphia: American Regulator Company, manufacturing appliances for the automatic regulation of temperatures; capital, $10,000; treasurer, Elizabeth A. Smith, 436 Mutual Life Building, 1011 Chestnut street, Philadelphia.

Pittsburg: The Enscoe Manufacturing Company, manufacturing gas and electric fixtures, heaters, tools and machines; capital, $25,000; treasurer, Franklin Enscoe, Pittsburg.

Pittsburg: Fiber Barrel Machinery and Manufacturing Company, manufacturing fibrous cylindrical packages and machinery for manufacturing them; capital $5,000; treasurer, Morris Walsh, Jr., 327 Charles street, Knoxville.

Butler: Kelly Plaster Company, mining and manufacturing gypsum and all products made therefrom; capital, $150,000; treasurer, J. F. Anderson, Reiber Block, Butler.

Schuylkill Haven: Schuylkill Haven Foundry Company, manufacturing cast iron pipes and other articles of iron or steel or any other metal, and machine castings, cast iron and ornamental work and plumbers' supplies; capital stock, $60,000; treasurer, Emanuel H. Baker, Schuylkill Haven, Schuylkill county.

Philadelphia: The Gas Illuminating Company, of Freeland, manufacturing gas for light; capital, $5,000; treasurer, W. C. Anderson, Kingston.

York: Home Furniture Company, manufacturing furniture; capital, $125,000; treasurer, D. W. Gerber, York.

Philadelphia: The Machine Spinning Company, manufacturing cotton, woolen and other yarns; capital, $10,000; treasurer, Thomas Crompton, 2739 North Thirteenth street, Philadelphia.

Pittsburg: Model Cigar Company, manufacturing cigars and stogies; capital, $10,000; treasurer, Charles Tannenbaum, Pittsburg.

Philadelphia: Magarge & Green Company, manufacturing of all kinds of paper; capital, $50,000; treasurer, Thomas J. Hare, Overbrook.

Philadelphia: Royal Dental Manufacturing Company, manufacturing surgical instruments and supplies; capital, $15,000; treasurer, Alexander J. Brian, Fortieth street and Parkside avenue, Philadelphia.

York: York Cut Stone Company, manufacturing all kinds of stone, marble and granite work; capital, $50,000; treasurer, George F. Birchall, York.

Huntingdon: Warrior Lime and Stone Company, mining, quarrying and manufacturing, sandstone, limestone, lime, clay, brick and so on; capital, $5,000; treasurer, Samuel I. Spyker, Huntingdon.

Shamokin: Twentieth Century Shoe Company; capital, $40,000; treasurer, H. J. Kimmel, Mt. Carmel.

Pittsburg: Colonial Supply Company, mine and mill supplies, capital, $50,000; treasurer, J. L. McKnight, 1765 Frick Building Annex, Pittsburg.

Pittsburg: Goldsmith Furniture Company, capital, $15,000; treasurer, Maurice S. Levenson, Turtle Creek.

Logan's Ferry, Allegheny county: Land and Liberty Corporation, manufacturing dairy products; capital, $6,000; treasurer, Isaac Rothberg, 1205 Locust street, Pittsburgh.

Philadelphia: Sarfert Knitting Mills Company, manufacturing fabrics; capital, $200,000; treasurer, Peter Hernig, 2009 Mascher street, Philadelphia.

Philadelphia: The Colburn-Hohmeyer Company, manufacturing spices; capital, $5,000; treasurer, Charles D. Joyce, Swarthmore.

Philadelphia: David Berg Distilling Company, capital, $100,000; treasurer, David Berg, 1715 Jefferson street, Philadelphia.

Wayne township, Lawrence county: The Beaver Valley Lime Company, mining, burning and crushing limestone; capital, $10,000; treasurer, E. O. Wikoff, New Castle.

Philadelphia: Chelton Electric Company, manufacturing electrical supplies; capital, $10,000; treasurer, Alfred M. Worth, 117 W. Chelten avenue, Philadelphia.

Hanover: Hanover Cabinet Company, manufacturing furniture; capital, $25,000; treasurer, C. A. Reaser, Gettysburg.

Butler: Butler Planing Mill Company, incorporated; capital, $100,000; treasurer, George Dillich, Butler.

Branchton, Butler county: The Osborne Company, quarrying limestone and manufacturing products from it; capital, $10,000; treasurer, W. C. Osborne, Keister, Butler county.

Ellwood City, Lawrence county: Ellwood City Iron and Wire Company, manufacturing structural iron and steel and ornamental iron and wire products; capital, $15,000; treasurer, Samuel D. Johnston, Ellwood City.

Philadelphia: Ideal Light Company, manufacturing hardware, plumbers' supplies and all kinds of lighting fixtures, capital, $10,000; treasurer, Julian L. Van Thuyne, 425 Vine street, Philadelphia.

East Vandergrift, Westmoreland county: Vandergrift Ice Company; capital, $30,000; treasurer, G. W. Braden, Hyde Park.

Brockwayville, Jefferson county: The Brockway Oil and Gas Company, operating for oil and gas; capital, $25,000; treasurer, W. G. Curry, Brockwayville.

Pittsburg: Chalfant Coal Company; capital, $5,000; treasurer, A. M. Bell, 2003 Union Bank Building, Pittsburg.

East Stroudsburg, Monroe county: East Stroudsburg Lumber Company, capital, $25,000; treasurer, T. Y. Hoffman, East Stroudsburg.

Columbia: Eureka Box Factory Company, manufacturing boxes; capital, $10,000; treasurer, John R. Bucher, Columbia.

Philadelphia: Edwards and Bacon, manufacturing wearing apparel; capital, $20,000; treasurer, Charles W. Bacon, Germantown, Philadelphia.

Philadelphia: Ferguson Carpet Company, manufacturing carpets and other textile fabrics; capital, $50,000; treasurer, Lincoln Ferguson, 51 Rex avenue, Philadelphia.

Philadelphia: The Frank S. Olmes Company, manufacturing gloves; capital, $5,000; treasurer, Walter T. Sullivan, 4833 Hazel avenue, Philadelphia.

Bangor: Bangor Slate Mining Company, quarrying and mining slate and manufacturing slate products; capital, $75,000; treasurer, B. W. Ribble, Bangor.

Philadelphia: John Steigerwald & Company, manufacturing cigars and cigarettes; capital, $150,000; treasurer, E. P. Balderston, 1622 Westmoreland street, Philadelphia.

Williamsport: J. E. Dayton Company, manufacturing shoes; capital, $250,000; treasurer, Charles W. Scott, Williamsport.

Lock Haven, Clinton county: Lock Haven Auto Company, manufacturing automobiles, motor boats and motor cycles; capital, $5,000; treasurer, A. C. Candor, Lock Haven.

Mifflinburg, Union county: The Mifflinburg Body and Gear Company, manufacturing bodies, gears and other parts of vehicles; capital, $30,000; treasurer, Horace W. Orwig, Mifflinburg.

Lebanon: Paul H. Light & Company, manufacturing plumbing and heating and ventilating apparatus; capital, $5,000; treasurer, Paul H. Light, Lebanon.

Pottsville: Schuylkill-Lehigh Coal Company, mining coal; capital, $5,000; treasurer, Harry L. Maize, Pottsville.

Philadelphia: True Shape Hosiery Company, manufacturing hosiery and fabrics; capital, $50,000; treasurer, Earnest Blood, 75 High street, Germantown, Philadelphia.

Philadelphia: T. S. Johnson Sons Company, constructing heating systems; capital, $5,000; treasurer, T. S. Johnson, 1609 North Eighth street, Philadelphia.

Waynesboro: The Wayne Paint Company; manufacturing paints and enamels; capital, $10,000; treasurer, John Welty, Waynesboro.

Celia, Beaver county: Connoquessing Valley Canning Company, manufacturing cereals and preserving fruits and vegetables; capital, $10,000; treasurer, F. B. Woods, Celia.

Pittsburg: Mining and Cooking equipment Company, manufacturing machinery and appliances pertaining to the mining and coal and coke industries; capital, $5,000; treasurer, Richard F. Bentlich, 6544 Green street, Chicago.

General

Scranton: The directors of the Hudson Coal Company have increased the capital stock of the corporation from $100,000 to $2,500,000.

Easton: The Victor Balata and Textile Belting Company has increased its capital from $24,000 to $100,000.

Bath: An increase of capital stock from $500,000 to $860,000 has been authorized by the Pennsylvania Cement Company.

Stroudsburg: The Stroudsburg Ribbon Mills has increased its indebtedness from nothing to $30,000.

Punxsutawney: The Punxsutawney Coal Mining Company has increased its indebtedness from $30,000 to $110,000.

Philadelphia: The William Amer Manufacturing Company has increased its stock from $200,000 to $220,000.

Ambridge: The Keystone Sheet Metal Company has increased its stock from $50,000 to $100,000.

Point Marion: An increase in capital stock from $20,000 to $30,000 has been decided upon by the Cheat River Glass Company.

Canton, Bradford county: The indebtedness of the Halfleet-McNulty Table Company has been increased from nothing to $50,000.

Easton: The Mountain Ice Company of Pennsylvania has authorized an increase of its indebtedness from nothing to $250,000.

Pittsburg: The Pittsburg White Sand Company has increased its capital from $25,000 to $100,000.

Allentown: An increase in stock from $10,000 to $35,000 has been authorized by the American Union Cordial Company of Pennsylvania.

Philadelphia: The North American Lace Company has increased its capital from $1,500,000 to $2,000,000.

Pittsburg: The Jackson Motor Supply Company has increased its capital from $5,000 to $10,000.

Philadelphia: The Fegley Fire Chain Company has increased its capital stock from $5,000 to $100,000.

Kane: The La Mont Chemical Company has increased its indebtedness from nothing to $25,000.

Franklin: The Pemrick Oil Company has authorized an increase of capital stock from $5,000 to $200,000.

Philadelphia: The Berwick Gas Company has increased its capital stock from $100,000 to $410,000, and its indebtedness from nothing to $300,000.

Lost Creek Valley, Juniata County: The Lost Creek Valley Rural Telephone Company has increased its capital from $5,000 to $25,000.

Hollenbrook, Luzerne county: The Hollenbrook Telephone Company has increased its capital from $5,000 to $20,000.

Mechanicsburg: The D. Wilcox Manufacturing Company has increased its stock from $120,000 to $202,500.

Greensburg: The Keystone Coal and Coke Company has increased its indebtedness from $2,500,000 to $6,000,000.

North Huntingdon township, Westmoreland county: The Jersey Cereal Food Company has authorized an increase in capital stock from $200,000 to $500,000.

Shickshinny: The Farmers Telephone and Supply Company has increased its stock from $10,000 to $25,000.

Lititz: The Ideal Cocoa and Chocolate Company has increased its indebtedness from nothing to $280,000.

Kennett Square: The American Road Machine Company has authorized an increase in the capital stock from $250,000 to $1,000,000.

McKeesport: An increase in indebtedness from nothing to $175,000 has been authorized by the Thomas Moore Distillery Company.

Philadelphia: The Sterling Lumber Company has increased its capital stock from $10,000 to $25,000.

York: The H. Washbers York City Laundry has increased its indebtedness from nothing to $43,000.

Pittsburg: The East end Mantel and Tile Company has increased its indebtedness from nothing to $21,125.

Pittsburg: The Castalia Portland Cement Company has increased its capital from $410,000 to $460,000.

Pittsburg: The Union Switch and Signal Company has increased its capital from $2,500,000 to $5,000,000.

Chester: The Blair Silica Brick Company has authorized an increase on its indebtedness from nothing to $75,000.

Beaver: The H. C. Fry Glass Company has reduced its capital from $400,000 to $300,000.

LIGHT, HEAT AND POWER.

Charters

Pittsburg: Arona Electric Company, manufacturing light, heat and power by electricity for borough of Arona, Westmoreland county; capital, $5,000; treasurer, George T. Smith, Cain and Dursan avenues, Pittsburg.

Pittsburg: Derry Township Electric Company; capital, $5,000; treasurer, Earl Beach, Hotel Hamilton, N. S., Pittsburg.

Pittsburg: Forward Electric Company; capital, $5,000; treasurer, R. C. Lightcap, 107 Allen avenue, Knoxville.

Pittsburg: Lower Tyrone Electric Company; capital, $5,000; treasurer, C. C. McBride, 32 Chapman street, Ingram.

Pittsburg: Madison Borough Electric Company; capital, $5,000; treasurer, H. C. Miller, McKeesport.

Pittsburg: Redstone Electric Company; capital, $5,000; treasurer, C. R. Lurton, Centre avenue, Aspinwall.

Pittsburg: Upper Tyrone Electric Company; capital, $5,000; treasurer, C. W. Scheck, Mt. Lebanon.

Scranton: Archibald Light, Heat and Power Company; capital, $5,000; treasurer, Frederick W. Stillwell, Y. M. C. A. Building, Scranton.

Scranton: Dunmore Electric Company; capital, $5,000; treasurer, Frederick W. Stillwell, Y. M. C. A. Building, Scranton.

Scranton: Lackawanna Light, Heat and Power Company; capital, $5,000; treasurer, Frederick W. Stillwell, Y. M. C. A. Building, Scranton.

Scranton: Peoples Light, Heat and Power Company of Scranton; capital, $5,000; treasurer, Frederick W. Stillwell, Y. M. C. A. Building, Scranton.

Scranton: Pioneer Electric Company; capital, $5,000; treasurer, Frederick W. Stillwell, Y. M. C. A. Building, Scranton.

Irvona, Clearfield county: Irvona Light, Heat and Power Company; capital, $5,000; treasurer, A. R. Hunter, Irvona.

West Chester: Chester County Public Service Company, capital, $5,000; treasurer, Matthew F. Maury, Wissahickon avenue and Manheim street, Philadelphia.

West Chester: West Chester Heating Company, capital, $5,000; treasurer, Matthew F. Maury, Philadelphia.

Limerick township, Montgomery county: Suburban Electric Company of Limerick, capital, $5,000; treasurer, Dr. William J. Ashenfelter, Pottstown.

East Vincent township, Montgomery county: Suburban Electric Company of East Vincent, capital, $5,000; treasurer, H. M. Blake, 223 South Third street, Philadelphia.

Upper Providence Township, Montgomery county: Suburban Electric Company of Upper Providence; capital, $5,000; treasurer, H. M. Blake, 223 South Third street, Philadelphia.

East Pikeland township, Chester county: Suburban Electric Company of East Pikeland; capital, $5,000; treasurer, H. M. Blake, 223 South Third street, Philadelphia.

Lebanon: Hebron Electric Light and Power Company; capital $5,000; treasurer, Daniel Weaver, Lebanon.

Clymer, Indiana county: Payne Electric Company, supplying light, heat and power; capital, $5,000; treasurer, A. J. Musser, Clearfield.

Clymer, Indiana county: Brady Electric Company; capital, $5,000; treasurer, A. J. Musser, Clearfield.

Marion Centre, Indiana county: Marion Light, Heat and Power Company; capital, $5,000; treasurer, A. J. Musser, Clearfield.

Hazleton: Ashley Power Company; capital, $5,000; treasurer, C. J. Kirschner, Hazleton.

Hazleton: The Hanover Power Company; capital, $5,000; treasurer, C. J. Kirschner, Hazleton.

Pittsburg: Mt. Pleasant Township Electric Company, supplying light, heat and power to the public in Mt. Pleasant township, Westmoreland county; capital, $5,000; treasurer, E. B. Beach, Hotel Hamilton, N. S., Pittsburg.

East Coventry township, Chester county: Suburban Electric Company of East Coventry; capital, $5,000; treasurer, H. M. Blake, 223 South Third street, Philadelphia.

Allentown: South Allentown Gas Company, supplying gas for light and heat in Salisbury township and South Allentown, Lehigh county; capital, $5,000; treasurer, I. W. Morris, 38 Summit street, Chestnut Hill, Philadelphia.

Lehigh township, Northampton county: Albion Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Palmer township, Northampton county: Beechwood Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Washington Township, Lehigh county: Diamond Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Pittsburg: North Irwin Electric Company; capital, $5,000; treasurer, C. W. Scheck, Mt. Lebanon.

Hazleton: The Wilkes-Barre Power Company, capital, $5,000; treasurer, treasurer, C. J. Kirschner, Hazleton.

Hazleton: The Wilkes-Barre Power Company, capital, $5,000; treasurer, C. J. Kirschner, Hazleton.

Hazleton: Wright Power Company; capital, $5,000; treasurer, C. J. Kirschner, Hazleton.

Pittsburg: Centreville Electric Company; capital, $5,000; treasurer, F. J. Taylor, Homestead.

General

Clearfield: The capital stock of the Greene Heat, Light and Power Company has been increased from $10,000 to $15,000.

Pittsburg: The Allegheny Valley Light Company has increased its capital from $150,000 to $250,000.

Philadelphia: The Chester Valley Electric Company has increased its stock from nothing to $750,000.

Butler: The Butler Light, Heat and Power Company has increased its capital from $50,000 to $200,000 and its indebtedness from $50,000 to $100,000.

Steelton: The Steelton Light, Heat and Power Company has increased its capital stock from $60,000 to $100,000.

Wilkes-Barre: The indebtedness of the Wilkes-Barre Light, Heat and Power Company has been increased from nothing to $100,000.

Strasburg, Lancaster county: The Strasburg Electric Light, Heat and Power Company has increased its capital from $50,000 to $70,000.

Lancaster: The Edison Electric Illuminating Company has increased its capital from $525,000 to $675,000.

Williamsport: The Edison Electric Illuminating Company has authorized an increase in stock from $100,000 to $120,000.

RAILWAYS.

General

Pittsburg: The Pittsburg, Neville Island and Coraopolis Railway Company has filed its intentions at the State Department of its intention to extend the route this spring a distance of two and a half miles.

Philadelphia: The Terminal Railway Company will extend its route in Upper Darby township, Delaware county.

Johnstown: The Johnstown Passenger Railway Company will extend its route for two and seven-tenths miles this spring over streets within the boundaries of this city.

Wilkes-Barre: The Wilkes-Barre and Luzerne Railway Company will extend its lines into the borough of Luzerne.

Pittsburg: The Transverse Passenger Railway Company will make an extension of route within the city of Pittsburg.

Mount Carmel: The Mount Carmel and Locust Gap Transit Company will extend its route in Mount Carmel township, Northumberland county.

Erie: A charter has been issued for the Erie and Suburban Railway Company and will construct its routes in Millcreek and Harborcreek townships, Erie county.

SEWERAGE.

General

Old Forge, Lackawanna county: This town will at once construct a storm drain and sanitary sewer along Main street, a distance of one mile and a half. Plans for a comprehensive sewerage system will be drawn during the summer.

Ligonier, Westmoreland county: This borough will vote on the question of constructing a sanitary sewage system and a sewage disposal plant. Work will be started at once. F. H. Shaw, of Lancaster, is the consulting engineer.

Parker City: The State Health department has ordered this municipality to institute extensive sanitary improvements, requiring sewer construction.

Westmoreland county: The Valley Camp Association, Lower Burrell township, Westmoreland county, will build a sewage disposal plant this spring. The engineers in charge are Chester & Fleming, of Pittsburg.

Norwood, Delaware county: Norwood has voted for a sanitary sewage system and plans have been drawn by A. F. Damon, Jr., of Darby. These plans have been approved by the State Health Department.

South Bethlehem: This borough has purchased a site for the erection of a sewage disposal plant. The location has been approved by the State health officials. Borough Engineer R. E. Neumeyer is engaged in preparing comprehensive plans for a sanitary sewage system and a sewage disposal works for South Bethlehem, Bethlehem, Fountain Hill and Northampton Heights.

Springdale, Allegheny county: Springdale will build a sanitary sewer system this season, and will join with Cheswick borough in purchasing a site upon which to construct sewage disposal works in the future by both jointly, the expenses to be met by the two municipalities.

Berks county: The Bethany Orphans' Home, Heidleberg, Berks county, will build a system of sewers and a sanitary sewage disposal plant this season.

West Chester, Chester county: Two sewage disposal plants will be constructed here this year. One of them will drain the Taylor Run Valley and the other Goose Creek Valley. A. F. Damon, Jr., of Darby, is the engineer.

Norristown: A sewage disposal plant, which will not only be a benefit to the people of the State Insane Hospital, but indirectly to the residents of Norristown and Philadelphia and others living along the Schuylkill river, is just being completed at the grounds of the State Hospital.

Masontown: Chester & Fleming, Consulting Engineers, Union Bank Building, Pittsburg, Pa., are preparing plans for a sewage disposal plant for the Borough of Mastontown, Pa., in connection with Mr. E. C. Baker, City Engineer.

STREETS AND ROADS.

Proposals

Harrisburg: Until the present Legislature appropriates money for State highways, few contracts will be let for road building by the State Highway Department. The Sproul main highway bill provides $4,000,000 for the two years, beginning June 1, for State roads and $2,000,000 for State-aid highways. The building of the 7,000 miles of highways contemplated in the bill is not entirely contingent upon the passage of the joint resolution permitting the voters of the State to say whether or not a bond issue of $50,000,000 shall be floated for road building. If this resolution pass this year it must be passed by the next Legislature and the people cannot vote upon it until 1913.

Harrisburg: Over twenty miles of streets are to be paved here this year. Most of the awards for this work have already been made, but other bids will be opened during the spring.

Philadelphia: On April 17 bids will be opened for repairs to asphalt paved streets occupied by the tracks of the Philadelphia Rapid Transit Company. The amount of money available for this purpose is $200,000. The sum of $40,000 is set aside for making repairs to streets paved with granite blocks and a similar fund for those highways paved with vitrified bricks.

WATER WORKS.

Permits

Bellevue, Pa.: Plans and specifications are being prepared by Chester & Fleming, Consulting Engineers, Union Bank Building, Pittsburg, Pa., for a concrete lining for a large circular masonry reservoir belonging to the Ohio Valley Water Company at Bellevue, Pa. This work will be completed at an early date.

Harrisburg: The Water Supply Commission of Pennsylvania has approved the following applications:

Fayette county: Dickerson Run Water Company, for the supply of the public in the village of New Dickerson Run, Dunbar and Franklin townships, Fayette county.

Pittsburg: Pennsylvania Railroad Company, for permission to make an extension to the east bank of the Allegheny river between points 51.4 and 52.0 miles north of Pittsburg.

The following applications were considered and held under advisement:

Red Hill: Red Hill Water Company, for the supply of water to the public in the borough of Red Hill, Montgomery county.

Lancaster county: Florin Water Company, for the supply of water to the public in the township of Mount Joy, Lancaster county.

Towanda: Towanda Water Power Company, for permission to erect a dam in the North Branch of the Susquehanna river, near Towanda.

Venango county: Pennsylvania Railroad Company, for permission to make a fill in the Allegheny river south of East Sandy Station, Venango county.

Charters

Johnstown: A charter has been issued to The Water Sterilizer and Filter Company, manufacturing water sterilizers and filters; capital, $50,000; treasurer, B. F. Price, Johnstown.

General

Matamoras: The indebtedness of the Matamoras Citizens Water Company has been increased from $23,000 to $38,100.

Scranton: The Spring Brook Water Supply Company has increased its capital from $5,000,000 to $7,500,000.

Lemoyne, Cumberland county: The Riverton Consolidated Water Company has increased its capital from $100,000 to $200,000.

Engineers' Society of Pennsylvania

THIRD SERIES. MAY, 1911 No. 5.

MONTHLY BULLETIN

ENGINEERING WORK PROPOSED

In this column is published each month news relating to proposed engineering work in Pennsylvania, as far as such information is obtainable. This service will be useful to contractors and the trade in Builders' Supplies. The items of interest embrace engineering constructive work of all kinds and degrees of magnitude. Send in the notes to the Secretary Editorial Staff, on or before the first day of each month.

BUILDINGS.

Charters

Pittsburg: Dawson Construction Company, engaging in a general contracting, building and engineering business; capital, $15,000; treasurer, George Dawson, Bellevue.

Philadelphia: Philadelphia Construction Company, builders and engineers; capital, $25,000; treasurer, William Humphrey, Berlin, N. J.

Pittsburg: Cummings Structural Concrete Company, constructing buildings, wharves, docks, roads and railroads; capital, $5,000; treasurer, R. A. Cummings, 6203 Stanton avenue, Pittsburg.

Pittsburg: R. Lamont & Sons' Company, contractors for all kinds of buildings; capital, $5,000; treasurer, M. A. Lamont, 1221 Lincoln avenue, Pittsburg.

Reading: Reading Contracting Company, designing, contracting and engineering; capital, $10,000; treasurer, William H. Miller, Jr., Reading.

INDUSTRIAL.

Charters

Philadelphia: G. H. P. Cigar Company, manufacturing cigars; capital, $15,000; treasurer, B. L. Grabosky, 1516 North Sixteenth street, Philadelphia.

Philadelphia: Kensington Planing Mill Company, manufacturing lumber and woodware; capital, $5,000; treasurer, Samuel Rollison, 2043 East Auburn street, Philadelphia.

Bangor: Bangor Structural and Roofing Slate Company, mining and quarrying slate and manufacturing slate products; capital, $5,000; treasurer, E. G. Markley, Bangor.

Lancaster: P. N. Hershey Candy Company, manufacturing confectionary; capital, $10,000; treasurer, E. . Sterner, Lancaster.

Bloomsburg: Fred Fear Match Company, manufacturing matches, tooth picks, wood boxes and wood and metal novelties; capital, $25,000; treasurer, Fred Fear, Bloomsburg.

Reading: The I. A. Deisher Company, manufacturing jewelry, watches, clocks and silverware; capital, $5,000; treasurer, W. Morris Deisher, 808 North Fifth street, Reading.

Philadelphia: John Blood & Bro., Incorporated; manufacturing textile goods; capital stock, $100,000; treasurer, Edward Blood, 1318 Arrott street, Frankford, Philadelphia.

Pittsburg: The Physicians' System Company, manufacturing accounting and recording forms; capital, $10,000; treasurer, A. C. Ellis, 302 Renshaw Building, Pittsburg.

Pittsburg: Consolidated Stone and Mining Company, quarrying and mining limestone, sandstone, fireclay and shale and manufacturing them into merchantable products; capital, $100,000; treasurer, Gomer E. Ingham, Ellwood City.

Hanover: The United Engine and Manufacturing Company, manufacturing thermal engines, tractors and accessories; capital, $20,090; treasurer, Robert E Manley, 505 Madison avenue, New York.

Pittsburg: The Eureka Steel Company of Pittsburg; capital, $25,000; treasurer, John J. Rattigan, Homestead.

Moosic, Lackawanna county: Moosic Manufacturing Company, manufacturing canvas, woolen goods and cotton goods; capital, $10,000; treasurer, William McDonald, Moosic .

Philadelphia: Motor Distributing Company, manufacturing motor vehicles, motor boats, aerovehicles and accessories; capital, $10,000; treasurer, Clinton H. Miller, 253 South Forty-sixth street, Philadelphia.

Scranton: Pocket Umbrella Company, manufacturing novelties; capital, $10,000; treasurer, H. E. Black, Scranton.

Scottdale, Westmoreland county: The American Steel and Iron Company; capital, $5,000; treasurer, J. A. Stauffer, Scottdale.

Pittsburg: Cameron Carpet Company, manufacturing floor coverings and upholstery goods; capital, $5,000; treasurer, Fred Ernst, 605 East North avenue, Pittsburg.

North East, Erie county: Stow Lumber and Coal Company, manufacturing articles of commerce of lumber; capital, $20,000; treasurer, W. L. Stow, North East. Sto,w Lumber and Coal Company, No. 2; capital, $5,000; treasurer, W. L. Stow, North 9ast.

Bloomsburg: American Elevator Company, manufacturing elevators, dumb waiters, etc.; capital, $5,000; treasurer, Clyde C. Yetter, Bloomsburg.

Philadelphia: Brod Bros. & Zeisler, Incorporated, manufacturing textile articles; capital, $20,000; treasurer, Joseph Brod, 5154 Hoopes street, Philadelphia.

Clifton Heights: Caledonia Woolen Mills; capital, $50,000; treasurer, Harry Miller, 940 South Sixth street, Philadelphia.

Pittsburg: Crescent Paste Co., manufacturing pastes and oils; capital, $50,000; Hunt B. Miller, Wilkinsburg, Allegheny county.

West Mead township, Crawford county: The City Ale Brewery of Meadville, manufacturing malt liquors; capital, $80,000; treasurer, A. E. Wagner,, Meadville.

Philadelphia: Edward D. Kruse Company, manufacturing confectionary; capital, $20,000; treasurer, Anne M. Kruse, 3500 Powelton avenue, Philadelphia.

Pittsburg: The H. N Crosby Company, manufacturing vinegars and table condiments; capital, $10,000; treasurer, A. M. Bingham, No. 315 North Blakely street, Dunmore.

Philadelphia: Lockwood Folding Box Company, manufacturing boxes of wood and paper; capital, $5,000; treasurer, J. B. McKeage, 2515 South Colorado street, Philadelphia.

Moosic: The Moosic Coal Company, mining coal; capital, $10,000; treasurer, John Cotter, Luzerne county.

Homestead: Paul Stan Company, manufacturing iron and steel; capital, $10,000; treasurer, Edward E. Franenheim, Pittsburg.

York: Sterling & Son Company, manufacturing products from milk, cream and fruit; capital, $5,000; treasurer, Walter J. Forrest, 34 East Philadelphia, York.

Danville: The Shaw Producing Company, manufacturing confectionary; capital, $5,000; treasurer, A. H. Woolley, Danville.

Dorrancetown, Luzerne county: Dorrancetown Hosiery Mills Company; capital, $20,000; treasurer, Charles Birth, Dorrancetown.

West Reading, Berks county: Fehr Knitting Company; capital, $8,000; treasurer, Ezra J. Moyer, Reading.

Philadelphia: Lenhart Manufacturing Company, manufacturing automobile lamps and supplies; capital, $10,000; treasurer, Jefferson I. Lenhart, 2301 South Sixty-seventh street, Philadelphia.

Pottsville: Lewis C. Thompson Company, manuafcturing hardware, mining supplies and general merchandise; capital, $20,000; treasurer, J. Harry Benner, Pottsville.

Meadville: The Meadville Lumber Manufacturing Company; capital, $10,000; treasurer, F. C. Baker, Meadville.

Philadelphia: Pressed Steel Shuttle Company; capital, $10,000; treasurer, Augustine F. Hall, 1432 Christian street, Philadelphia.

Philadelphia: Pollock Huston Company, manufacturing carpets and rugs; capital, $300,000; treasurer, Thomas Huston, Trenton avenue and Dauphin street, Philadelphia.

Harrisburg: Roumfort Baking Company; capital, $10,000; treasurer, Walter P. Maguire, Harrisburg.

Beaver, Beaver county: Sash Hanger Manufacturing Company; capital, $10,000; treasurer, E. P. Yost, Aliquippa, Beaver county.

Conneaut Lake: Taylor Manufacturing Company, manufacturing mops and handles and household appliances; capital, $10,000; treasurer, C. C. Johnston, Conneaut Lake.

Philadelphia: Persian Rug Renovating Company, manufacturing rugs and carpets; capital, $5,000; treasurer, William A. Tees, 4137 Cambridge street, Philadelphia.

Scranton: Sprague and Hinwood, Incorporated, manufacturing core drills out of steel; capital, $100,000; treasurer, W. R. Osborne, 745 Quincy avenue, Scranton.

Harrisburg:. Thorley Baking Company, manufacturing bread and similar products; capital, $5,000; treasurer, S. W. Thomas, Harrisburg.

Somerset: White's Creek Lumber Company; capital, $45,000; treasurer, J. H. Beerits, Somerset.

Sayre, Bradford county: The Woodin Chemical Company; capital, $25,000; treasurer, W. L. Dorsett, Sayre.

Pittsburg: Cherry Run Mining Company, mining coal and manufacturing coke; capital, $50,000; treasurer, J. M. Taylor, 803 Lewis Block, Pittsburg.

Lebanon: Miller Brothers, Incorporated, manufacturing lumber and its products; capital, $100,000; treasurer, Samuel Mentzer, Hebron, Lebanon county.

General

Pittsburg: The Keystone Hair Insulator Company has increased its capital stock from $50,000 to $150,000.

Lebanon: The Lebanon Table Works Company has decided upon an increase in capital stock from $25,000 to $50,000 .

Chester: The American Road Machine Company has increased its capital from $250,000 to $1,000,000.

Greensburg: The capital stock of the Vunadium Alloy Steel Company has been increased from $200,000 to $300,000.

Mountainville, Lehigh county: The capital of the Mountainville Telephone Company Limited, has been increased from $800 to $1,400.

Scranton: The Globe Silk Manufacturing Company has increased its capital stock from $50,000 to $100,000.

Corry: The Corry Castor Company has voted to increase its capital stock from $30,000 to $50,000.

Warren: The Pennsylvania Gas Company has increased its capital from $800,000 to $4,800,000.

Pittsburg: The Thomas Moore Distillery Company has increased its indebtedness from nothing to $175,000.

Philadelphia: The stock of the Montgomery County Ice and Cold Storage Company has been decreased from $100,000 to $25,000.

Lehigh county: The Joseph S. Mack Silk Company has increased its capital from $150,000 to $200,000.

Franklin: The Venango Printing Company has increased its stock from $15,000 to $120,000.

Philadelphia: The Glen Willow Ice Manufacturing Company has increased its stock from $250,000 to $350,000.

Lehigh county: The Prudential Slate Company has authorized an increase in its capital stock from $100,000 to $300,000 .

Franklin: The Pamrick Oil Company has increased its capital stock from $5,000 to $200,000.

Luzerne county: The Morris Run Coal Mining Company has increased its capital stock from $450,000 to $1,000,000.

Pittsburg: The Sterling Steel Foundry Company has increased its capital stock from nothing to $127,500.

Pittsburg: The directors of the Central Tube Company have increased its capital from $350,000 to $500,000.

Columbia county: The Fred Fear Match Company has increased its capital stock from $25,000 to $500,000.

Crawford county: .The Brownell Shoe Company has increased its capital stock from $50,000 to $100,000.

York: The York Manufacturing Company has decided upon an increase in capital stock from $1,500,000 to $2,000,000.

Union county: The Franklin Brick and Clay Company has increased its indebtedness from nothing to $25,000.

Johnstown: The National Radiator Company has increased its capital from $350,000 to $1,500,000.

Somerset: The Somerset Smokeless Coal Company has increased its capital from $5,000 to $2,500,000.

Philadelphia: The Highland Gas Company has increased its capital stock from $10,000 to $147,000.

Mechanicsburg: The D. Wilcox Manufacturing Company has decided upon an increase in capital stock from $150,000 to $250,000.

Philadelphia: The Hutchison Baking Company has increased its indebtedness from nothing to $35,000.

Philadelphia: The directors of the Kitterlinus Lithographic Manufacturing Company have increased the capital of the company from $500,000 to $600,000.

Philadelphia: The Hadfield Hosiery Company has increased its capital stock from $5,000 to $100,000.

Philadelphia: The Alva Carpet and Rug Company has increased its capital from $100,000 to $200,000.

Newtown: The Eastburn Place Guernsey Dairy and Ice Company has increased its capital stock from $20,000 to $24,000.

Greensburg: The Salina Fire Brick Company has increased its capital from $5,000 to $175,000.

Clearfield: The Goshen Coal Company has increased its stock from $5,000 to $50,000.

Philadelphia: The Madison Spinning Company has increased its indebtedness from nothing to $30,000.

LIGHT, HEAT AND POWER.

Charters

East Allen township, Northampton county: East Allen Electric Company, supplying light, heat and power to the public in East Allen township; capital, $10,000; treasurer, B. F. Baker, Germantown.

Plainfield township, Northampton county: Excelsior Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Whitehall township, Lehigh county: Equitable Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Forks township, Northampton county: Greenwood Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Hanover township, Lehigh county: Hazard Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Lower Saucon township, Northampton county: Lower Saucon Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Lower Nazareth township, Northampton county: Capital $10,000; treasurer, H. F. Baker, Germantown.

Lower Mount Bethel township, Northampton county: Capital, $10,000; treasurer, H. F. Baker, Germantown.

East Penn township, Carbon county: Lizard Creek Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Mauch Chunk township, Carbon county: Lehigh Navigation Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Moore township Northampton county: Moore Township Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Mahoning township, Carbon county: Nesquehoning Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

North Whitehall township, Lehigh county: North Whitehall Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Salsbury township, Lehigh county: Oakdale Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Allen township, Northampton county: Orchard Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Packer township, Carbon county: Panther Creek Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Bethlehem township, Northampton county: Primrose Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Washington township, Northampton county: Standard Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Hanover township, Northampton county: Skidmore Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Bushkill township, Northampton county: Star Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

South Whitehall township, Lehigh county: South Whitehall Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Upper Nazareth township, Northampton county: Upper Nazareth Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Upper Mount Bethel township, Northampton county: Upper Mount Carmel Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Upper Macungie township, Lehigh county: Upper Macungie Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Upper Milford township, Lehigh county: Upper Milford Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Steelton: Swatara Light, Heat and Power Company; capital, $5,000; treasurer, Frederick E. Scott, Scranton.

Pittsburg: Union Township Electric Company; capital, $5,000; treasurer, J. S. Tannehill, Canonsburg.

Logan township, Blair county: Mountain Electric Light, Heat and Power Company; capital, $10,000; treasurer, Walter W. Perkins, Philadelphia.

Shamokin: Black Diamond Light, Heat and Power Company; capital, $5,000; treasurer, William W. Ryon, Shamokin.

Mount Carmel, Northumberland county: The Mount Carmel Light, Heat and Power Company; capital, $50,000; treasurer, B. F. Crist, Mount Carmel.

Pittsburg: Mahan Electric Company, to supply the borough of McMahan, Westmoreland county; capital, $5,000; treasurer, F. J. Taylor, Homestead.

Pittsburg: Penn Borough Electric Company; capital, $5,000; treasurer, H. C. Miller, McKeesport.

Lock Haven: Clinton Electric Company; capital, $5,000; treasurer, Ernest H. Davis, Williamsport.

Corry: The Corry Power Company, supplying light, heat and power by means of electricity; capital, $10,000; treasurer, Sumner A. Orr, Warren.

Lock Haven: Avis Light, Heat and Power Company; capital, $5,000; treasurer, W. Harry Baker, Harrisburg.

Lock Haven: Clinton Light, Heat and Power Company; capital, $5,000; treasurer, W. Harry Baker, Harrisburg.

Lock Haven: Patterson-Scootac Light, Heat and Power Company; capital, $5,000; treasurer, W. Harry Baker, Harrisburg.

Lock Haven: Susquehanna Light, Heat and Power Company; capital, $5,000; treasurer, W. Harry Baker. Harrisburg.

Lock Haven: West Branch Light, Heat and Power Company; capital, $5,000; treasurer, W. Harry Baker, Harrisburg.

Erie: Erie Lighting Company; capital, $50,000; treasurer, E. D. Carter, Erie.

Norristown: Treddyffrin Electric Company; capital, $5,000; treasurer, Herbert H. Ganser, Norristown.

Norristown: Upper Merion Electric Company; capital, $5,000; treasurer, Herbert H. Ganser, Norristown.

Warren, Warren county: Warren Light, Heat and Power Company; capital, $10,000; treasurer, C. T. Conarro, Warren.

West Chester: East Goshen Electric Company; capital, $5,000; treasurer, George V. Smith, 2029 Pine street, Philadelphia.

West Chester: East Whiteland Electric Company; capital, $5,000; treasurer, George V. Smith, 2029 Pine street, Philadelphia.

West Chester: West Whiteland Electric Company; capital, $5,000; treasurer, George V. Smith, 2029 Pine street, Philadelphia.

West Chester: Willistown Electric Company; capital, $5,000; treasurer, George V. Smith, 2029 Pine street, Philadelphia.

East Telford: Bucks County Light Company, manufacturing gas; capital, $5,000; Harry W. Stoll, Cape May Court House, N. J.

Harborcreek, Erie county: Harborcreek Township Electric Company; capital, $10,000; treasurer, R. W. Mott, 2031 East Chelten avenue Philadelphia.

Northeast: Northeast Township Electric Company; capital, $10,000; tricity; capital, $10,000; treasurer, R. W. Mott, 2031 East Chelten avenue, Philadelphia.

Northeast: Northeast Township Electric Company;) capital, $10,000; treasurer, R. W. Mott, 2031 East Chelten avenue, Philadelphia.

Millcreek, Erie county: Waldameer Electric Light Company; capital, $10,000; treasurer, R. W. Mott, 2031 East Chelten avenue, Philadelphia.

Harrisburg: Twenty gas and electric manufacturing companies, to operate in half a dozen counties, were chartered by Governor Tener this month. The central office of all these companies is Philadelphia and the capital stock in each instance is $5,000. W. T. Robinson, of Philadelphia, is the treasurer of all of the score of new corporations. The companies and the places where they will operate are as follows:

Gas Illuminating Company of Delaware, in the townships of Upper Chichester, Bethel, Concord, Birmingham, Aston, Thornbury, Middletown, Edgemont, Marple, Upper Providence and Chester, all in Delaware county.

The Gas Company of the West Side, in the boroughs of Shickshinny and Larksville and the townships of Pringle, Hunlock and Union, in Luzerne county.

The Gas Company of Delaware County, in the boroughs of Aldan, Prospect Park, Upland, Marcus Hook, Swarthmore, Rutledge, Morton and Milburn, in Delaware county.

The Gas Company of Rockledge, in the borough of Rockledge, Montgomery county.

Horsham Township Electric Company, in the township of Horsham, Montgomery county.

The Southampton Township Electric Company, in the township of Southampton, Bucks county.

Upper Dublin Township Electric Company, in the township of Upper Dublin, Montgomery county.

Whitpain Township Electric Company, in the township of Whitpain, Montgomery county.

Warminster Township Electric Company, in the township of Warminster, Bucks county.

Warwick Township Electric Company, in the township of Warwick, Bucks county.

Hunlock Township Electric Company, in the township of Hunlock, Luzerne county.

Jackson Township Electric Company, in the township of Jackson, Luzerne county.

Lake Township Electric Company, in the township of Lake, Luzerne county.

Lehman Township Electric County, in the township of Lehman, Luzerne county.

Larksville Electric Company, in the borough of Larksville, Luzerne county.

Pringle Township Electric Company, in the township of Pringle, Luzerne county.

Sugar Notch Electric Company, in the borough of Sugar Notch, Luzerne county.

Shickshinny Electric Company, in the borough of Shickshinny, Luzerne county.

Union Township Electric Company, in the township of Union, Luzerne county.

Warrior Run Electric Company, in the borough of Warrior Run, Luzerne county.

The West Wyoming Electric Company, in the borough of West Wyoming, Luzerne county.

General

Philadelphia: The Titusville Light, Heat and Power Company has increased its capital from $5,000 to $150,000; this company's indebtedness has been increased from nothing to $150,000.

Mount Gretna, Lebanon county: The Mount Gretna Light, Heat and Power Company has increased its capital from $5,000 to $12,500.

Wilkes-Barre: The Wilkes-Barre Light Company has increased its indebtedness from $100,000 to $1,000,000.

Philadelphia: The West Conshohocken Gas Light Company has increased its indebtedness from nothing to $425,000.

Mount Carmel: The Edison Electric Illuminating Company has increased its capital from $75,000 to $150,000.

Hummelstown: The Hummelstown Gas and Fuel Company has increased its indebtedness from nothing to $35,000.

West Chester: The Chester County Electric Company has increased its indebtedness from nothing to $50,000.

Millersburg: The Millersburg Electric Light, Heat and Power Company has increased its indebtedness from $10,000 to $21,000.

MISCELLANEOUS.

Charters

Peters township, Franklin county: Fort Loudon and Cove Gap Telephone Company, connecting Fort Loudon, Foltz and Mercersburg; capital, $5,000; treasurer, Joseph Rotz, Fort Loudon, Franklin county.

Packer township, Carbon county: The Packer Township Telephone Company; capital, $5,000; treasurer, Joseph F. Horn, Weatherly, Packer township.

RAILWAYS.

General

Pittsburg: The Morningside Electric Street Railway Company will make extensions of its routes from this city and to Sharpsburg, a distance of 2,500 feet.

Erie: The Erie and Suburban Railway Company will extend its lines two and one-half miles this summer

Perkasie: The Lehigh Valley Transit Company will extend its lines here.

Irwin: The Irwin-Herminie Traction Company will make extensions to its route to Yukon.

Beaver county: The Beaver Northern Street Railway Company will build five miles of roadway in Big Beaver township, Beaver county.

Pittsburg: The Allegheny and Northwestern Railway Company has increased its capital stock from $70,000 to $150,000.

Reading: The Reading Transit Company has increased its indebtedness from nothing to $20,000,000.

Erie: The Erie and Suburban Railway Company has increased its indebtedness from nothing to $3,000,000.

Harrisburg: The Ohio Iron and Metal Company of Pittsburg has filed a complaint with the State Railroad Commission against the Pittsburg, Chartiers and Youghiogheny and the Pennsylvania Railroad Companies relative to switching charges between the tracks of these respondents.

Pittsburg: The Pittsburg and North Eastern Railroad and the Pittsburg and North Eastern Terminal Railroad have filed papers with the Secretary of the Commonwealth setting forth their intention to merge.

SEWERAGE.

General

Harrisburg: The decree of the State Health Commissioner regarding the sewage conditions of Harrisburg, relative to the construction of a $316,000 river front interceptor, the improvement of conditions along Paxton creek and other sewage problems, will be made to Councils the latter part of May.

Masontown, Fayette county: A sewage disposal plant will be erected by this municipality this season.

Bristol, Bucks county: Plans have been drawn by William H. Boardman, engineer, for a sewage system and sewage disposal plant for this place.

Plymouth, Luzerne county: An extensive sewage system will be installed here this summer.

STREETS AND ROADS.

Proposals

Harrisburg: The following dates for the opening of bids for the construction of State highways have been fixed by State Highway Commissioner Hunter:

Snyder county, Selinsgrove township, May 18.
Juniata county, Delaware township, May 24.
Mifflin county, Armaugh township, May 24.
Tioga county, Wellsborough, May 23.
Northumberland county, Delaware township, May 25.
Sullivan county, Colley township, May 24.
Clarion county, Beaver township, May 24.
Bedford county, East St. Clair township, May 25.
Fayette county, Wharton township, May 25.
York county, Fawn township, May 29.
Warren county, Pine Grove township, May 26.

General

Harrisburg: A petition has been approved at the State Highway Department for the building of a State highway in Armaugh township.

Harrisburg: During the present year twenty-five miles or more of paving will be done in this city. Most of the contracts for this work have been let under the loan of 1910, which provided $100,000 for the city's share of the street improvements. Asphalt will be used exclusively in the work.

Port Clinton, Schuylkill county: This borough has petitioned the State Highway Department for aid in building 3,000 feet of highway.

Harrisburg: The Sproul main highway bill has been amended so that instead of $4,000,000 being provided for State roads the sum of $3,000,000 is fixed, and $1,000,000, instead of $2,000,000 is provided for State-aid roads.

Harrisburg: Among the recent applications received at the State Highway Department for State aid for road building are the following:
York county, Chanceford township, 31,680 feet.
Washington county, Hanover township, 8,200 feet.
Greene county, Gilmore township, 26,400 feet.
Wayne county, Honesdale, 6,540 feet.
Mercer county, West Middlesex township, 5,280 feet.

WATER SUPPLY.

General

Mount Carmel: The Mount Carmel Water Company has inecrased its capital from $100,000 to $150,000.

Benton: The Benton Water Company has increased its indebtedness from nothing to $30,000; its capital stock from $1,000 to $10,000.

Ligonier: During the past month the proposition to issue bonds for a water works system and a sewage system here was lost in an election by seven votes.

Eden, Bucks county: The Frederick Rumpf's Woolen Mills Company will be fitted with a trades waste disposal plant to handle the spent dye liquors. William H. Boardman, Philadelphia, is the engineer.

Clarion: The Clarion Water Company will erect a filter plant this summer. Chester & Fleming, of Pittsburg, are the engineers.

Masontown, Fayette county: Plans have been approved by the State Department of Health for a water filter plant, the engineers being Chester & Fleming, of Pittsburg.

Perkasie, Bucks county: The Perkasie Water Supply Company has obtained a new source of supply and will build a water filter system. The engineer in charge of the work is R. E. Neumeyer, of South Bethlehem.

Bethlehem: The borough of Bethlehem has won a victory through the action of the State Supreme Court, which has reversed the Northampton county court and has held that the borough has the right to construct its own municipal water plant.

Harrisburg: The State Water Supply Commission has heard the application of the corporation of Pittsburg men who desire to dam the Tionesta creek and the Clarion river, in Clarion county. The plan proposed is the construction of dams 300 feet high. Protests from Clarion county residents have been made and no decision has been reached.

Neville Island: The Ohio Valley Water Company has awarded the contract for drilling the additional 12-inch wells for the water supply on Neville Island, to J. M. Allen, of Pittsburg. Chester & Fleming, Engineers, Union Bank Building, Pittsburg, have charge of this work.

Bellevue: The Ohio Valley Water Company has awarded the contract for lining the supply reservoir at Bellevue to Pihl & Miller, of Pittsburg. Chester & Fleming, of Pittsburg, are Consulting Engineers o nthe work.

Engineers' Society of Pennsylvania

THIRD SERIES. JUNE, 1911 No. 6.

MONTHLY BULLETIN

ENGINEERING WORK PROPOSED

In this column is published each month news relating to proposed engineering work in Pennsylvania, as far as such information is obtainable. This service will be useful to contractors and the trade in Builders' Supplies. The items of interest embrace engineering constructive work of all kinds and degrees of magnitude. Send in the notes to the Secretary Editorial Staff, on or before the first day of each month.

BRIDGES.

Proposal

Reading: Sealed proposals will be received at the office of County Controller A. L. Rhoads, of Berks county, on June 28, for the erection of the substructure of the Kutztown bridge, No. 1.

BUILDINGS.

Proposals

Hazleton: A time for the asking of bids for the erection of the proposed city hall for this place will shortly be fixed by councils. Six architects have drawn plans for a building costing approximately $75,000.

Harrisburg: Governor Tener has approved bills for $478,000 for the completion of the buildings at the Rittersville Hospital for the Insane. The new commission will shortly fix a date for the submission of bids for the work.

Greensburg: Paul A. Bartholomew, of this place, with Andrew McMasters, of Pittsburg, has been selected as architect for the new Westmoreland County Hospital for the Insane. The new hospital will be located on the tract recently purchased for the purpose in Hempfield township, about two miles east of Greensburg.

Charters

Ambridge, Beaver county: The Ohio Valley Lumber Company, manufacturing lumber and building materials; capital, $50,000; treasurer, Charles E. Harris, Ambridge.

INDUSTRIAL.

Charters

Pittsburg: A. F. Schwerd Manufacturing Company, manufacturing wooden columns and other products of wood; capital, $10,000; treasurer, A. H. Schwerd, 3556 McClure avenue, Pittsburgh.

Philadelphia: Betsey Ross Manufacturing Company, manufacturing wearing apparel; capital, $5,000; treasurer, Jacob A. Schwarz, 5132 Wayne avenue, Germantown.

Scranton: The J. L. Lutsey Company, manufacturing ice cream and milk and dairy products; capital, $5,000; treasurer, J. L. Lutsey, 903 Prescott avenue, Scranton.

Wilkinsburg: Modern Electric and Manufacturing Company, manufacturing gas and electric appliances and supplies; capital, $20,000; treasurer, Elliott Frederick, 8 Grace street, Pittsburgh.

Manheim: Manheim Manufacturing and Belting Company, manufacturing belting and hose; capital, $100,000; treasurer, M. G. Hess, Manheim.

Philadelphia: The Motor Truck Company, Incorporated; capital, $25,000; treasurer, Oscar Loeb, 19 St. Paul's Road, Ardmore.

Mount Morris, Green county: Shear Oil and Gas Company, mining, drilling and boring for petroleum, oil and gas; capital, $16,000; treasurer, J. H. Barrick, Mount Morris.

Parker's Landing, Armstrong county: Parker Cup and Specialty Works, manufacturing pump cups and specialties capital, $5,000; treasurer, Alfred A. Schenck. Parker's Landing.

Scranton: Barium Products Company, manufacturing products from barium and other chemicals; capital, $40,000; treasurer, Henry W. Kingsbury, Scranton.

Newcastle: Bauman Manufacturing Company, manufacturing food products from gelatine, sugar, vanilla beans, oils, etc.; capital, $100,000; treasurer, Darley Vandivort, Newcastle.

Philadelphia: Max Zeitler Engraving and Supply Company, manufacturing stamping and embossing presses; capital, $50,000; treasurer, Charles J. Hendler. 2560 North Seventeenth street, Philadelphia.

College Hill, Beaver county: The Porceliron Company, manufacturing stoves and other articles; capital, $25,000; treasurer, M. N. Hurd, College Hill.

Pittsburg: Accurate Metal Company, manufacturing of iron or steel structural and ornamental steel, iron and wire work; capital, $5,000; treasurer, William C. Klein, Fair Haven.

Philadelphia: Ford Chain Block and Manufacturing Company, manufacturing chain blocks; capital, $30,000; treasurer, Richard G. Park, Jr., Seventeenth and Chestnut streets, Philadelphia.

Wilmerding: The Millar Automatic Chuck Company, manufacturing chucks and other mechanical devices; capital. $30,000; treasurer, C. W. Millar, 613 Seventh avenue, Carnegie.

Philadelphia: P. C. Pure Food Company, manufacturing cereal and other food products; capital, $5,000; treasurer, E. G. Middleton, Haddonfield, N. J.

Pittsburg: Water Works Supply Company, capital, $10,000; treasurer, Thomas H. Verner, 811 Shaw avenue, McKeesport.

Philadelphia: Atlantic Type Foundry Company, manufacturing type and type metals; capital, $10,000; treasurer, C. Edward Dilkes, 1912 Arch street, Philadelphia.

Pittsburg: The Automat Company of America, manufacturing vending machines; capital, $25,000; treasurer, J. O. Wallace, Pittsburg.

Philadelphia: Alloway-Martin Company, manufacturing carriages, wheels, automobile bodies; capital, $5,000; treasurer, M. Henry Goodwin, Bingham Hotel, Philadelphia.

Pittsburg: Belden Engineering Company, manufacturing automobiles, trucks, motor boats, aeroplanes and motor vehicles; capital, $25,000; treasurer, Edward H. Belden, 720 Bessemer Building, Pittsburg.

Reading: Joseph Bancroft & Sons Company of Pennsylvania, manufacturing fabrics; capital, $250,000; treasurer, Earl S. Jenckes, Wilmington, Del.

Philadelphia: Knipe Manufacturing Company, manufacturing ball bearings; capital, $5,000; treasurer, Charles Lund, 5559 Locust street, Philadelphia.

Philipsburg, Centre county: Philipsburg Silica Sand Company, mining and quarrying sand for commercial purposes; capital, $200,000; treasurer, George R. Reynolds, Lewistown.

Philadelphia: Gates Home Made Candies, manufacturing confectionary; capital, $20,000; treasurer, Benjamin D. Gates, 2614 Kensington avenue, Philadelphia.

Pittsburg: The Interior Marble and Tile Company; capital, $10,000; treasurer, A. P. Harrison, 2515-16 Oliver Building, Pittsburg.

Freeland, Luzerne county: The Washington Silk Company of Freeland, manufacturing silk; capital, $35,000; treasurer, B. F. Davis, treasurer, Freeland.

Downingtown: Watco Knitting Company, manufacturing, dyeing and bleaching knit and woven fabrics; capital, $25,000; William M. Anglemoyer.

West Middlesex, Mercer county: The George W. Mason Engineering and Manufacturing Company, manufacturing water heaters and other mechanical contrivances; capital, $10,000; treasurer, Charles M. Pierce, Sharon.

Philadelphia: Keystone Novo Company, manufacturing iron and steel; capital, $5.000; treasurer, W. Nelson Mayhew, 117 East Mount Pleasant avenue, Philadelphia.

Philadelphia: Sylvan Worsted Company, manufacturing textile fabrics; capital, $25,000; treasurer, Frederick F. Arnold, Providence, R. I.

Philadelphia: Henry Lehmuth Company, manufacturing hosiery; capital, $100,000; treasurer, George H. Lehmuth, 1509 West Allegheny avenue, Philadelphia.

Schuylkill Haven: J. F. Bast & Sons, manufacturing, dyeing and bleaching print goods; capital, $10,000; treasurer, J. F. Bast, Schuylkill Haven.

Philadelphia: The Southern Bake Shop Company, manufacturing bread and confections; capital, $5,000; treasurer, Walter Woodcock, 1632 North Sixtieth street, Philadelphia.

Coal Company, mining coal and other minerals; capital, $35,000; treasurer, George E. McFetridge, Creighton.

Pittsburg: Pittsburg Amiesite Company, manufacturing artificial road and highway surfacing from stone, cement and bituminous and other substances; capital, $10,000; treasurer, Donald McNeil, 908 Adelaide street, Pittsburg.

New Cumberland: Pennsylvania Dye and Bleach Works, Incorporated; manufacturing and dyeing cotton and woolen fabrics; capital, $50,000; treasurer, Samuel F. Peters, New Cumberland.

Somerset township, Somerset county: The Somerset Ice and Supply Company, manufacturing ice and maintaining a system of cold storage; capital, $20,000; treasurer, M. J. Pritts, Somerset.

Pittsburg: Armstrong, Wolf, Zimmerman Company, manufacturing tools and supplies for mines, mills, railroads, bridges, breweries and buildings; capital, $15,000; treasurer, Madison S. Wolfe, Sewickley.

Pittsburg: Electric Welding Company, manufacturing appliances consisting of plates, bars, hooks, links for use in concrete or metal construction work and conducting a machine shop business; capital, $5,000; treasurer, R. A. Cummings, 6203 Stanton avenue, Pittsburg.

Bangor: Flory Milling Company, manufacturing flour and feeds; capital, $85,000; treasurer, Harry E. Flory, 1431 Glenwood Road, Brooklyn.

East Deer township, Allegheny county: McFetridge Brothers Brick Company, manufacturing brick and tile; capital $30,000; treasurer, George E. McFetridge, Creighton; McFetridge Brothers.

General

Philadelphia: The Kensington Manufacturing Company has increased its indebtedness from nothing to $20,000.

Philadelphia: The Frankford Co-operative Manufacturing Company has filed a decree of dissolution at the Department of the Secretary of the Commonwealth.

Sunbury: The Sunbury Brick Company's holdings have been purchased by the Paxton Brick Company.

Pittsburg: The Allegheny Coal Company has increased its indebtedness from nothing to $600,000.

Wilkes-Barre: Miner-Hillard Milling Company has increased its capital stock from $500,000 to $750,000.

Pittsburg: The Superior Manufacturing Company has authorized an increase in its indebtedness from nothing to $25,000.

Valley Camp, Westmoreland county: The Valley Camp Coal Company has increased its indebtedness from nothing to $200,000.

Mount Joy: The Universal Hardware Works has increased its capital stock from $10,000 to $50,000.

Pittsburg: The Pennsylvania China Company has decided upon an increase in its capital stock from $100,000 to $200,000.

York: The York Manufacturing Company has increased its indebtedness from nothing to $750,000.

East Brady: The Valley Yarn and Woolen Company has increased its indebtedness from nothing to $6,000.

Pittsburg: The Diamond Coal and Coke Company has increased its stock from $400,000 to $600,000.

Philadelphia: The Madison Spinning Company has increased its indebtedness from nothing to $30,000.

Newtown, Bucks county: An increase in the capital stock of the Newtown Producing Company has been made from $60,000 to $100,000.

Harrisburg: The Thorley Baking Company has increased its capital from $5,000 to $100,000.

Hanover: Mummert, Wolf & Dixon Company has authorized an increase of capital from $20,000 to $50,000.

Philadelphia: Pressed Steel Shuttle Company has increased its capital from $10,000 to $100,000.

Pittsburg: Washington Tin Plate Company has decided upon an increase of capital stock from $300,000 to $350,000; its indebtedness has been increased from $136,000 to $200,000.

Philadelphia: The Persian Rug Renovating Company has increased its capital stock from $5,000 to $25,000.

Danville: The Nam-Trah Knitting and Spinning Company has increased its indebtedness from nothing to $20,000.

Charleroi: The Charleroi Foundry and Machine Company has increased its indebtedness from nothing to $7,500.

LIGHT, HEAT AND POWER.

Charters

Philadelphia: Fuel Gas Company of Dauphin County, manufacturing and supplying gas in the county of Dauphin outside of Harrisburg; capital, $5,000; treasurer, I. W. Morris, 38 Summit street, Chestnut Hill, Philadelphia.

Chester: Chester Township Electric Company; capital, $5,000; treasurer, W. H. Wohnus, Chester.

Union City, Erie county: Keystone Electric Light and Power Company; capital, $10,000; treasurer, O. S. Wallace, Union City.

Adams Township, Cambria county: Adams Township Light, Heat and Power Company; capital, $5,000; treasurer, Eugene A. Delaney, Windber.

Cressona, Schuylkill county: Eastern Pennsylvania Light, Heat and Power Company of Cressona; capital, $5,000; treasurer, C. E. Calder, Pottsville.

Richland township, Cambria county: Richland Township Light, Heat and Power Company; capital, $5,000; treasurer, Eugene A. Delaney, Windber.

Pittston: The Pittston Heat, Power and Light Company; capital,

$150,000; treasurer, James H. Shea, 299 East South street, Wilkes-Barre.

South Fork, Cambria county: Croyle Township Light, Heat and Power Company; capital, $5,000; treasurer, Albert M. Stineman, South Fork.

Wilkes-Barre: Wyoming Electric Company; capital, $5,000; treasurer, George S. Alexander, Wilkes-Barre.

Smithton, Westmoreland county: The Smithton Light, Heat and Power Company; capital, $20,000; treasurer, Van A. Reed, Jr., Elizabeth, Allegheny county.

General

West Chester: The Chester County Electric Company has increased its indebtedness from nothing to $50,000.

Millersburg: The Millersburg Electric Light, Heat and Power Company has authorized an increase in its indebtedness from $10,000 to $21,000.

Erie: The Erie Lighting Company has increased its indebtedness from nothing to $2,000,000; its capital stock from $50,000 to $2,000,000.

Pittsburg: The Duquesne Light Company has authorized an increase of capital stock from $500,000 to $3,000,000.

Lebanon: The Annville and Palmyra Gas and Fuel Company has increased its capital stock from $100,000 to $150,000.

Pittsburg: The Pennsylvania Light, Heat and Power Company has increased its indebtedness from $150,000 to $500,000.

Mount Union: The Mount Union Light and Power Company has increased its stock from $25,000 to $60,000.

Punxsutawney: Jefferson Light, Heat and Power Company has increased its indebtedness from nothing to $50,000; its capital stock from $30,000 to $60,000.

Warren: The Warren Light and Power Company has increased its capital stock from $10,000 to $300,000; its indebtedness from nothing to $175,000.

Pittsburg: The Iron City Electric Company has increased its capital stock from $50,000 to $100,000.

Harrisburg: Papers recording the merger of twenty-two electric and gas companies in Columbia, Montour and adjoining counties, under the name of the Columbia Gas and Electric Company of Bloomsburg, have been filed at the Department of the Secretary of the Commonwealth. The capital of the consolidated company is to be $525,000 and the officers are: Edward R. Sponsler, Harrisburg, president; M. I. Low, Bloomsburg, vice-president; Albert W. Day, Bloomsburg, secretary, and M. Milleisen, Bloomsburg, treasurer. These same men are the officers of the Columbia and Montour Street Railway Company, which recently took over the Danville and Bloomsburg Railway Company.

Philadelphia: The West Conshohocken Fuel Gas Company has sold its franchise and property to the West Conshohocken Gas Light Company, which has also purchased the Whitemarsh Township Electric Light Company, the Whitemarsh Township Fuel Gas Company.

York: The Colonial Gas Company has increased its capital stock from $10,000 to $1,400,000; its indebtedness from nothing to $3,000,000.

RAILROADS.

General

Philadelphia: The Philadelphia Locomotive Works, with a capital stock of $50,000, has been organized by the men back of the Baldwin Locomotive Works. This is a step towards the reorganization of the old company. Governor Tener has issued a charter to the new company, whose incorporators are Rudolph Ellis, president of the Fidelity Trust Company; Charles S. W. Packard, president of the Pennsylvania Company for Insurance on Lives and Granting Annuities; E. B. Coxe, Jr., Alfred C. Harrison and Herman Dercum.

Philadelphia: The Philadelphia Railways Company has authorized an increase in its indebtedness from nothing to $400,000.

Erie: The Erie and Suburban Railway Company has increased its indebtedness from nothing to $3,000,000.

Scranton: The Scranton, Dunmore and Moosic Lake Railroad Company has increased its capital from $250,000 to $300,000.

Bedford: The Bedford and Hollidaysburg Railroad Company and the Bedford and Bridgeport Railroad Company have merged and formed the Hollidaysburg, Bedford and Cumberland Railroad Company.

Danville: The Danville and Bloomsburg Street Railway Company and the Columbia and Montour Electric Railway Company have merged, forming the Columbia and Montour Electric Railway Company.

Titusville: The Titusville Electric Traction Company has increased its indebtedness to $1,250,000.

Harrisburg: The following companies have filed certificates with the Secretary of the Commonwealth, signifying their intention to extend their lines:

The woodlawn and Southern Street Railway Company.
The Duquesne Street Railway Company .

College Hill: The Beaver Northern Street Railway Company has been chartered with a capital stock of $30,000. It will have a five-mile length of road and operate in Lawrence county. J. S. Herron, Pittsburg, is president.

SEWERAGE.

Charters

Pittsburg: Ben Avon Heights Sewer Company, construction of sewers, culverts, conduits and pipes in township of Kilbuck, Allegheny county; capital, $5,000; treasurer, W. P. Fraser, Ben Avon.

STREETS AND ROADS.

Harrisburg: Work on the paving of twenty-five miles of streets in this city has started.

Philadelphia: Proposals will be received on June 20 by George R. Stearns, director, at the Department of Public Works, for grading streets, paving streets with refined asphalt, vitrified brick, fire clay and shale blocks, granite blocks, granolithic, macadam with vitrified brick gutters, repaving streets with asphalt, curbing, paving, repaving and repairing sidewalks at the expense of the property owners and also similar work at the expense of the city, repairing and resurfacing asphalt paved streets occupied by the tracks of the Philadelphia Rapid Transit Company, for repaving and resurfacing with asphalt on Spring Garden street, between Broad and the intersection of Spring Garden street, Ridge avenue and Twelfth street, and for the removal of obstructions.

WATER SUPPLY.

General

Harrisburg: The members of the State Water Supply Commission may visit the sites covered by the applications for the Clarion River Power Company, in connection with which hearings were recently held at the State Capitol.

Masontown: The contract for the water filtration plant for the borough of Masontown has been awarded to the Pitt Construction Company, of Pittsburg, who were the lowest bidders. Chester &

Fleming, Union Bank Building, Pittsburg, are the consulting engineers for the work, and Mr. E. C. Baker is city engineer.

Polk: The State Institution for Feeble-Minded at Polk, Pa., has employed the firm of Chester & Fleming, engineers, Union Bank Building, Pittsburg, to design and install a hypochloride treatment plant for the auxiliary water supply of the institution.

Conemaugh: The Conemaugh and Franklin Water Company has increased its capital from $20,000 to $200,000; its indebtedness from $5,000 to $30,000.

Pittsburg: The Fallstown Water Company has increased its capital stock from $1,000 to $5,000; its indebtedness from nothing to $10,000.

Harrisburg: The Rutherford Heights Water Supply Company has increased its indebtedness from nothing to $100,000.

Connellsville: The Connellsville Water Company has authorized an increase of indebtedness from $490,000 to $750,000.

Engineers' Society of Pennsylvania

THIRD SERIES. JULY, 1911 No. 7.

MONTHLY BULLETIN

ENGINEERING WORK PROPOSED

In this column is published each month news relating to proposed engineering work in Pennsylvania, as far as such information is obtainable. This service will be useful to contractors and the trade in Builders' Supplies. The items of interest embrace engineering constructive work of all kinds and degrees of magnitude. Send in the notes to the Secretary Editorial Staff, on or before the first day of each month.

BRIDGES.

Proposals

Blairsville: Sealed proposals will be received by the borough council of Blairsville on July 20, for a steel concrete bridge, 130 feet in length. The bridge will be of the post and girder type and will extend over Sulphur Run. E. J. O'Brien, of Latrobe, is the engineer.

BUILDINGS.

Charters

Pittsburg: Schutz, Schreiner & Clyde Company have been granted a state charter to construct all kinds of buildings; capital, $15,000; Treasurer, A. J. Schutz, 1003 May Building, Pittsburg.

INDUSTRIAL.

Charters

Danielsville, Northampton county: Henry Quarries Company; mining and quarrying slate; capital, $10,000; treasurer, Tilghman Henry, Danielsville.

Philadelphia: Philadelphia Locomotive Works, the re-organized Baldwin works, manufacturing locomotives, trucks and railway and industrial equipment; capital, $50,000; treasurer, Herman Dercum, 5844 Overbrook avenue, Philadelphia.

Greensburg: Aaron Furniture Company; capital, $5,000; treasurer, Meyer Smyth, Greensburg.

Lehighton, Carbon county: The Diamond Iron Works, manufacturing iron and conducting a general foundry; capital, $30,000; treasurer, George E. Gray, Lehighton.

Pittsburg: Pittsburg Conduit Company, manufacturing conduit pipes, brick, tile and clay products; capital, $50,000; treasurer, H. S. McCandless, 4714 Second avenue, Pittsburg.

Bentleyville, Washington county: The Bentleyville Telephone Company, constructing telephone lines in Washington county, connecting with Ellsworth, Bentleyville and Monongahela; capital, $5,000; treasurer, C. K. Fry, Bentleyville.

Pittsburg: Journal Box Lifting Company, manufacturing iron or steel, jacks, journal box lifting apparatus and tools and machinery; capital, $5,000; treasurer, A. R. Bassett, Pittsburg.

Clarion: Buckingham Coal Mining Company, capital, $20,000; treasurer, John M. Curry, Clarion.

Pittsburg: Pittsburg Steel Forging Company, manufacturing steel or iron into horse shoes and other forgings; capital, $10,000; treasurer, S. Fritz, 5460 Penn avenue, Pittsburg.

Trafford: Van Ormer-Lose Wrench Company, manufacturing of iron or steel wrenches, machine tools and hardware specialties; capital, $75,000; treasurer, William Lose, Wilkinsburg.

Jersey Shore, Lycoming county: The Avis Gas Company, manufacturing gas for light only; capital, $5,000; treasurer, A. Grant Richwine, Mechanicsburg.

Jersey Shore, Lycoming county: The Avis Gas Fuel Company, manufacturing gas for heat and fuel; capital, $5,000; treasurer, A. Grant Richwine, Mechanicsburg.

Jersey Shore, Lycoming county: The Porter Gas Company, manufacturing gas for light; capital, $5,000; treasurer, A. Grant Richwine, Mechanicsburg.

Jersey Shore, Lycoming county: The Porter Gas Fuel Company, manufacturing gas for heat and fuel; capital, $5,000; treasurer, A. Grant Richwine, Mechanicsburg.

Meadville: The Sanitary Instrument Company, manufacturing surgical instruments; capital, $25,000; treasurer, James C. Shults, Meadville.

Whitemarsh township, Montgomery county: Lee Tire and Rubber Company, manufacturing rubber goods; capital, $100,000; treasurer, Albert A. Garthwaite, Conshohocken.

McKees Rocks, Allegheny county: Art Brass and Fixture Manufacturing Company, of Pittsburg, manufacturing gas and electric fixtures and art novelties; capital, $100,000; treasurer, L. R. Jeffords, Pittsburg.

Philadelphia: Blu-J-Tobacco Company manufacturing cigars and tobacco; capital, $10,000; treasurer, Coates Coleman, Swarthmore.

Catawissa: The Catawissa Knitting Mills; capital, $8,000; treasurer, C. P. Pfahler, Catawissa.

Scranton: The Diamond Oil and Paint Company; capital, $100,000; treasurer, William F. McGee, Scranton.

Philadelphia: F. A. Bochmann & Company, Incorporated, manufacturing textiles; capital, $375,000; treasurer, Paul C. Bochmann, 153 West Seventy-ninth street, New York.

Allentown: Griscom Stationery Company, manufacturing stationery and novelties; capital, $15,000; treasurer, Jacob P. Griesemer, Allentown.

Philadelphia: The Leblang-Gross Company, manufacturing lenses and optical instruments; capital, $5,000; treasurer, Isaac Leblang, 3644 North Broad street, Philadelphia.

Erie: Lakeside Forge Company, manufacturing steel and iron, capital, $100,000; treasurer, Frederick Bell McBrier, Erie.

Pittsburg: McCurdy Aeroplane Company, manufacturing aeroplanes; capital, $5,000; treasurer, Arthur L. S. McCurdy, Hotel Astor, New York.

New Castle: Rose Point Stone and Lime Company, manufacturing burnt lime and crushed stone; capital, $50,000; treasurer, Matthew Gunton, New Castle.

Harrisburg: Sun Medical Company, manufacturing medicines; capital, $30,000; treasurer, Joseph R. Coleman, Harrisburg.

Beaver Falls: United Games Concern, manufacturing games, toys and novelties; capital, $5,000; treasurer, Edward T. Fessenden, Beaver Falls.

Breezewood, Bedford county: McConnellsburg and Breezewood Telephone Company; capital, $15,000; treasurer, William C. Hanks, Charville.

Lancaster: New Process Steel Corporation, manufacturing bars, rods and tubes; capital, $50,000; treausrer, H. L. McClure, Lancaster.

Scranton: Pocono Distilling Company, manufacturing spiritous liquors; capital, $50,000; treasurer, Max F. Hinkleman, Scranton.

General

Pittsburg: The Diamond Coal and Coke Company has increased its capital from $400,000 to $600,000.

Philadelphia: The Harding-Findley Lumber Company has increased its stock from $15,000 to $25,000.

Pittsburg: The Snoe Shoe Fire Brick Company has authorized an increase of its indebtedness from nothing to $30,000.

Philadelphia: The Triangle Hosiery Mills Company has increased its capital stock from $60,000 to $75,000.

Greensburg: Mt. Pleasant-Connellsville Coke Company has increased its indebtedness from $500,000 to $1,000,000.

Philadelphia: The Black Creek Coal Company has increased its capital from $20,000 to $500,000; its indebtedness from $155,000 to $1,500,000.

Philadelphia: The General Motor Car Company has increased its indebtedness from nothing to $36,000.

Pittsburg: The Duquesne Steel Foundry Company has increased its capital stock from $300,000 to $1,200,000.

Hanover: Hanover Wire Cloth Company has increased its capital from $250,000 to $300,000.

Conshohocken: Lee Tire and Rubber Company has increased its capital from $100,000 to $1,600,000, its indebtedness from nothing to $400,000.

Marietta: The Penn Construction Company has reduced its capital from $60,000 to $10,000.

Reading: The Prince Furniture and Carpet Company has increased its indebtedness from $40,000 to $80,000.

Philadelphia: P. C. Pure Food Company has increased its capital from $5,000 to $150,000.

Planebrook: Silica Stone Works Company has increased its capital from $50,000 to $100,000.

York: York Knitting Mills Company has authorized an increase of capital from $50,000 to $150,000.

Ruffsdale: The Dillinger Distilling Company has increased its stock from $10,000 to $300,000.

Harrisburg: The Devine and Zungle Shoe Manufacturing Company has increased its indebtedness from nothing to $18,000.

South Bethlehem: The Bethlehem Foundry and Machine Company has increased its capital from $50,000 to $185,000, its indebtedness from $40,000 to $175,000.

Philadelphia: The S. S. White Dental Manufacturing Company has increased its capital from $1,000,000 to $5,000,000.

Reading: The Reading Hardware Company has increased its indebtedness from nothing to $250,000.

Johnstown: The Johnstown Telephone Company has increased its stock from $600,000 to $2,000,000.

Hartstown, Crawford county: The Fallowfield Telegraph and Telephone Company has increased its stock from $12,000 to $50,000.

Brownsville, Fayette county: The Dunn Connellsville Coke Company has increased its indebtedness from nothing to $17,500.

Harrisburg: The Harrisburg Steam Heat and Power Company has increased its capital from $150,000 to $300,000.

Watsontown: The Watsontown Brick and Clay Products Company has increased its indebtedness from nothing to $30,000.

Latrobe: The Latrobe Connellsville Coal and Coke Company has increased its indebtedness from $997,000 to $2,000,000.

Muncy: The West Branch Bell Telephone Company has increased its capital stock from $10,000 to $50,000.

West Chester: Chester County Public Service Company has increased its indebtedness from nothing to $413,750.

Bloomsburg: The United Gas and Electric Company has increased its capital stock from $130,000 to $159,800.

Pittsburg: Pittsburg Plate Glass Company has increased its stock from $17,500,000 to $22,750,000.

Latrobe: The Latrobe-Connellsville Coal and Coke Company has filed notice at the State Department of an increase of its capital stock from $997,000 to $2,000,000.

Conemaugh: The Conemaugh and Franklin Water Company has increased its capital from $5,000 to $30,000.

York: The York Knitting Mills Company has increased its capital stock from $50,000 to $150,000.

Scranton: The Pocket Umbrella Company has decided to increase its capital stock from $10,000 to $125,000.

Pittsburg: The Colonial Iron Company increased its stock from $200,000 to $282,000 at its last meeting.

LIGHT, HEAT AND POWER.

Charters

Coopersburg, Lehigh county: A charter has been issued to the Coopersburg Electric Light, Heat and Power Company; capital stock, $5,000; treasurer, R. D. Barron, Coopersburg.

Nanty Glo, Cambria county: Jackson Light Heat and Power Company, capital, $5,000; treasurer, Thomas P. Burns, Nanty Glo.

Lebanon: West Lebanon Electric Light and Power Company; capital, $5,000; treasurer, Daniel Weaver, Lebanon.

Ebensburg: Cambria Township Light Heat and Power Company; capital, $5,000; treasurer, Walter Jones, Ebensburg.

Stroud township, Manroe county: Blackstone Electric company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Rahn township, Schuylkill county: Eldon Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Schuylkill township, Schuylkill county: Fearne Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Ryan township, Schuylkill county: Gibson Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Smithfield township, Monroe county: Kent Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Blythe township, Schuylkill county: Marshall Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Mahanoy township, Schuylkill county: Mitchell Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Rush township, Schuylkill county: Sharswood Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Norweigian township, Schuylkill county: Story Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

East Norweigian township, Schuylkill county: Taney Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Washington: Amwell Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, 506 People's Building, Pittsburg.

Washington: Burgettstown Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Oakdale, Allegheny county: Collier Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, 506 People's Building, Pittsburg.

Washington: Canton Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Chartiers Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Canonsburg: Canonsburg Union Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Cecil Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

East Waynesburg: East Waynesburg Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: East Washington Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Waynesburg: Franklin Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Oakdale, Allegheny county: Findley Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Houston, Washington county: Houston Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Morris Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Oakdale: North Fayette Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: North Strabane Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: North Franklin Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Oakdale: Oak Borough Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Pleasant Valley Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

General

Warren: The Warren Light, Heat and Power Company has increased its capital stock from $10,000 to $300,000; its indebtedness from nothing to $175,000.

Pittsburg: The Iron City Electric Company has increased its capital stock from $50,000 to $100,000.

Philadelphia: The Schuylkill Gas and Electric Company has increased its indebtedness from nothing to $2,000,000; its capital from $5,000 to $1,000,000.

RAILWAYS.

General

Pittsburg: The Duquesne Street Railway Company has been authorized by the State Department to make an extension of its lines. Work will be started this summer.

Pittsburg: The West Penn Interurban Railway Company will build extensions this summer to its routes.

Erie: The directors of the Erie and Suburban Railway Company have decided upon extensions.

New Castle: The New Castle Electric Street Railway Company has authorized extensions of line.

Titusville: The Titusville Electric Company has voted to increase its indebtedness from $750,000 to $1,250,000.

Quakertown: The Quakertown and Eastern Railroad Company has reorganized under the name of the Quakertown and Delaware River Railroad Company.

Philadelphia: The Philadelphia Railways Company has increased its indebtedness from nothing to $400,000.

Erie: The Erie and Suburban Railways Company has increased its indebtedness from nothing to $3,000,000; its capital stock from $10,000 to $2,000,000.

Harrisburg: The State Forestry Commission has received its first applications for rights of way through a State reserve, under the act of 1911. These applications have come from railroads which desire to traverse State lands in Centre and Huntingdon counties for the purpose of developing their own adjoining properties.

Harrisburg: From June 1, 1901 to June 1, 1911, a period of ten years thirty new street railways were chartered in Pennsylvania.

SEWERAGE.

Proposal

Harrisburg: The Board of Public Works will, within a short time, advertise for bids for the construction of an intercepting sewer along the Susquehanna river front and for the construction of concrete sides and bottom for Paxton creek. The sum of $316,000 is available for the river sewer and $100,000 for the creek improvements. The plans for the interceptor have been before the State Health Department's sanitary engineers for some time; the creek improvement plans will soon be completed.

Ligonier, Westmoreland county: This borough is now advertising for bids for a municipal sewerage disposal plant. H. F. Shaw, of Lancaster, is the engineer.

Awards

New Castle: A contract has been let for the construction of a sanitary sewer in Mercer street. The price was $6,200.

General

New Castle: An ordinance has been introduced in Councils authorizing the city to vote on the question of raising a $500,000 fund by a special bond issue for the construction of a sewage disposal plant, an electric light works and for the repaving of streets.

Quakertown, Bucks county: Charles Mebus, of Philadelphia, has been engaged as the engineer to carry out this borough's plans for a system of sanitary sewers and a sewage disposal plant.

East Stroudsburg Monroe county: A. R. Brittian is building a system of sanitary sewers and a sewage disposal plant for a part of the borough. Clyde Potts, of New York, is the engineer.

Marianna, Washington county: Dr. Samuel G. Dixon, State Commissioner of Health, has ordered the sewage of this borough be kept out of the surface streams.

South Brownsville: South Brownsville, West Brownsville and Brownsville are studying a plan by which they can work out a joint system of sewers connecting with a single sewage disposal plant. James B. Hogg, of Pittsburg, is the engineer.

Monessen borough, Westmoreland county: Plans are being worked out for a sanitary sewage system and a sewage disposal plant for Monessen, West Monessen, Charleroi, North Charleroi and Donora. The engineer in charge is Alexander Potter, Monessen.

Hazleton, Luzerne county: Hazleton expects this summer to construct a sewage system.

STREETS AND ROADS.

Proposals

New Castle: This city on July 10, advertised for bids for re-paving Washington street, North street and Long avenue. On the same day bids for grading Mercer street were received by Councils, the yardage being 35,000.

Harrisburg: The City Highway Department will, within a short time, advertise for bids for the paving of several streets to complete the plan approved by the voters in 1910, when $100,000 was provided for paving. Twenty-five miles of streets are now being paved, but owing to competitors and consequent low prices, all of the original $100,000 has not been used up. Practically all of the paving being done is of asphalt.

Harrisburg: Following a tour of the entire State by State Highway Commissioner Bigelow, the work on the rebuilding of the Commonwealth's highways is expected to go ahead with speed. It is expected that the first road to be built under the provisions of the Sproul bill will be that through the Lewistown Narrows; then will follow a road from this city to Gettysburg. The river road from Harrisburg to Millersburg will be among the early work of the re-organised department. Dates for these roads will be announced shortly.

Awards

New Castle: A contract has been let for the grading of Atlantic avenue; the price was $18,000.

General

New Castle: A bond issue for $50,000 has been approved by the Mayor. This issue is for the repaving of the city's thoroughfares.

WATER SUPPLY.

Permits

Harrisburg: The Water Supply Commission of Pennsylvania, at its last meeting approved the following applications:

Wallenpaupack Power Company, for the storing, transportation and furnishing of water and water power.

Schuylkill Haven Gas and Water Company, for an addition to its source of supply.

Pennsylvania Railroad Company, for the construction of a concrete bridge in Chillisquaque creek, near Montandon Station, Northumberland county, Pennsylvania.

General

Harrisburg: The following hearings have been held by the Water Supply Commission:

On protest of citizens of Shickshinny against the inadequate supply of water by the Shickshinny Water Company in said borough;

On protest of citizens of Williamstown against the inadequate supply of water furnished by the Williams Valley Water Company;

The following applications were considered and held under advisement:

Ross Township Water Company, supplying water to the public in Ross Township, Luzerne county;

Weaverstown Water Company, supplying water to the public in the township of North Lebanon, Lebanon county.

Harrisburg: Work is nearing completion on the new 1,000,000 gallon capacity high service reservoir and pump house at Reservoir Park. Charles A. Hague, consulting engineer of the Harrisburg Water Commission, who drew the plans for these additions to the reservoir facilities died recently at his home in New York.

Fanconio township, Montgomery county: The Alliance Water Company will construct a water works system this summer.

West Telford borough, Montgomery county: The Telford Water Company will install drilled wells and a pumping station in order to supply this place with an adequate supply of water.

Hilltown township, Bucks county: The Hilltown Water Company will start work shortly on a water works system here. It will construct a standpipe and pumping station and take its water from the Telford Water Company.

Mahonoy City, Schuylkill county: The Mahonoy City Water Company will increase the capacity of Lofty reservoir by raising the breast of the dam. Work will be started at once.

Marianna, Washington county: The Marianna Water Company will build a water filter plant this summer.

Telford borough, Berks county: A water works system will be installed by the Rockville Water Company. A system of wells, a pumping station and a standpipe will be constructed.

Phoenixville: The borough authorities are considering the installation of a water filter works.

Landsford, Carbon county: The Panther Valley Water Company is considering the question of filtering the water of Nesquehoning creek for use in this borough.

Point View, Washington county: The Besta Coal Company will erect a water works system and the plans have been approved by the State Department of Health.

Wernersville: The State Lunatic Hospital is building a new reservoir and a water filter plant from the plans recently approved by the State Department of Health. Chester and Fleming, of Pittsburg, are the engineers.

Easton: The South Easton Water Company will extend its water works system and obtain a new source of supply from nearby springs.

York: The York Water Company will build one of the largest dams and impounding reservoirs in Pennsylvania. This company has always kept pace with the times in making improvements and it is one of the best managed systems in the state. George W. Fuller, of New York, is the consulting engineer.

Glen Rock, York county: Glen Rock, which last year was visited by a typhoid fever outbreak, is now engaged in solving the question of getting an additional source of pure water. Plans have been submitted to State Health Commissioner Dixon for a system of drilled wells.

Christiana: The Christiana Gravity Water Company is suffering from the lack of an adequate supply of water and is looking for a solution to the problem. An expert will probably be engaged.

Coopersburg, Lehigh county: This borough has desided to increase its source of water supply by drilling wells.

Harrisburg: The State Water Supply Commission will hold a hearing on July 25 on the protest against the incorporation of the Evitts Creek Water Company, which is designed to furnish the town of Cumberland, Md., with water. The protest has been entered before Governor John K. Tener and as it comes from Maryland it presents some unusual features. The commission late in July will visit the site of the proposed great dam at the juncture of the Clarion river and the Tionesta creek. So far the application for permission to erect this dam has been held under advisement by the commission.

Harrisburg: The Attorney General's Department will press the matter of taking the charter from the Suburban Water Company, of Luzerne county, on the ground that it has transacted no business since it was chartered in 1895. Quo warranto proceedings have been instituted in the Dauphin Courts.

Quarryville: The Quarryville Water Company has increased its indebtedness from $6,800 to $10,000.

Erie: The City of Erie has employed the firm of Chester & Fleming, Consulting Engineers, Union Bank Building, Pittsburg, Pa., to make a report and prepare preliminary plans and estimates for extensive improvements to the water works system of the city.

Phoenixville: The borough of Phoenixville has employed the firm of Chester & Fleming, Engineers, Union Bank Building, Pittsburg, to design and install a hypochloride treatment plant to disinfect the water supply for said borough, which is taken from the Schuylkill river.

Engineers' Society of Pennsylvania

THIRD SERIES. AUGUST, 1911 No. 8.

MONTHLY BULLETIN

PERSONAL NEWS

In this column is published each month personal news relating to members of the Society. The item of interest should be sent to the Secretary Editorial Staff, on or before the first day of each month. A member need not hesitate to give news about himself. Such co-operation is essential to the success of the Bulletin.

Mr. James C. Brooks, President of The Southwark Foundry & Machine Company, died on the 18th of July last, at Philadelphia.

GENERAL

The Southwark Foundry & Machine Company, of Philadelphia, has taken the American rights to build steam turbines in accordance with the designs which Prof. Rateau has developed in Europe.

ENGINEERING WORK PROPOSED

In this column is published each month news relating to proposed engineering work in Pennsylvania, as far as such information is obtainable. This service will be useful to contractors and the trade in Builders' Supplies. The items of interest embrace engineering constructive work of all kinds and degrees of magnitude. Send in the notes to the Secretary Editorial Staff, on or before the first day of each month.

BRIDGES.

Proposal

Harrisburg: Sealed proposals will be received by the County Commissioners of Dauphin county at noon, August 12, for the building of a concrete bridge over Paxton creek on the public road leading from Maclay street to Linglestown, in Susquehanna township; D. F. Lebo, clerk of the commissioners will supply plans and specifications.

General

Clearfield: The County Commissioners are about to build a reinforced concrete Arch highway bridge at Coalport. Two fifty-three foot spans, with side-walk. E. W. Hess, Engineer, L. C. Norris, Commissioners' Clerk.

Harrisburg: The Stucker Brothers Construction Company was the lowest bidder for the construction of a steel girder bridge over the right of way of the Reading Railway, its bid being $22,000. The Ferro Concrete Company, of this city, submitted a bid of $27,000 for a concrete bridge and Councils have failed to come to a decision, although Highway Commissioner Caldwell has recommended the Stucker bridge. The people of the city last year voted for $25,000 for the construction of the bridge and the incidental damages; the city will pay half the cost of construction and the railroad will pay the other half.

Pittsburg: The Pittsburg Bridge Company Iron Works has led at the State Department an increase of capital from $90,000 to $150,000.

Monessen: Monessen has employed the firm of Chester & Fleming, Consulting Engineers, Pittsburg, Pa., to prepare plans and specifications for a viaduct to span a deep gorge in the borough limits. The viaduct will probably be a reinforced concrete arched bridge of 150 feet span and will be constructed in the near future.

Phoenixville: The Borough of Phoenixville, Pa., has employed the firm of Chester & Fleming, Consulting Engineers of Pittsburg, to prepare detailed plans and specifications for the installation of a water filtration plant to treat the borough's water supply which is taken from the Schuylkill River.

BUILDINGS.

Charters

Pittsburg: Schutz, Schreiner & Clyde Company, contractors of buildings; capital, $15,000; treasurer, A. J. Schutz, 1003 May Building, Pittsburg.

Harrisburg: MacWilliams Construction Company; capital, $5,000; treasurer, G. M. Walter, Harrisburg.

Philadelphia: Borneman-Butler Construction Company, general engineering and contracting business; capital, $25,000; treasurer, Lewis E. Beitler, 1921 North Thirty-third street, Philadelphia.

Pittsburg: C. N. Neeld Construction Company, building mills, factories, furnaces and other structures;- capital, $10,000; treasurer, A. M. Neeld, 2243 Candace avenue, Pittsburg.

Philadelphia: Germantown Apartment Construction Company; capital, $5,000; treasurer, Isaac C. Sutton, 133 South Twelfth street, Philadelphia.

Punxsutawney: The McGovern Construction Company, buildings, bridges, railroads and highways; capital, $5,000; treasurer, George A. Sheldon, Punxsutawney.

Altoona: The Mausoleum Builders of Pennsylvania, building private and public community mausoleums; capital, $50,000; treasurer, G. W. Loudon, Altoona.

INDUSTRIAL.

Charters

Danielsville, Northampton county: Henry Quarries Company; capital, $10,000; treasurer, Tilghman Henry, Danielsville.

Reading: Mt. Laurel Spring Water Company, manufacturing non-alcoholic beverages; capital, $5,000; treasurer, Harry Hahn, Reading.

Philadelphia: Philadelphia Locomotive Works; capital, $50,000; treasurer, Herman Dercum, 5844 Overbrook avenue, Philadelphia.

Greensburg: Aaron Furniture Company, capital, $5,000; treasurer, Myer Smyth, Greensburg.

Lehighton, Carbon county: The Diamond Iron Works; capital, $30,000; treasurer, George E. Gray, Lehighton.

Pittsburg: Pittsburg Conduit Company, manufacturing conduit pipe, brick and tile; capital, $50,000; treasurer, H. S. McCandless, 4714 Second avenue, Pittsburg.

Bentleyville, Washington county: The Bentleyville Telephone Company; capital, $5,000; treasurer, C. K. Fry, Bentleyville.

Pittsburg: Journal Box Lighting Company, manufacturing jacks, tools, etc., capital, $5,000; treasurer, A. R. Bassett, Pittsburg.

Clarion: Buckingham Coal Mining Company; capital, $20,000; treasurer, John M. Curry, Clarion.

Pittsburg: Pittsburg Steel Forging Company, manufacturing iron or steel into horseshoes; capital, $10,000; treasurer, S. Fritz, Idaho Apartments, 5460 Penn avenue, Pittsburg.

Trafford: Van Ormer-Lose Wrench Company, manufacturing wrenches, machine tools and hardware specialties; capital, $75,000; treasurer, William Lose, Wilkinsburg.

Meadville, Crawford county: Sanitary Instrument Company, manufacturing surgical instruments, etc.; capital, $25,000; treasurer, James C. Shults, Meadville.

Whitemarsh township, Montgomery county: Lee Tire and Rubber Company, manufacturing goods and appliances from rubber; capital, $100,000; treasurer, Albert A. Garthwaite, Conshohocken.

McKees Rocks, Allegheny county: Art Brass and Fixtures Manufacturing Company, of Pittsburg; capital, $100,000; treasurer, L. R. Jeffords, Pittsburg.

Philadelphia: Blu-J-Tobacco Company, manufacturing cigars and tobaccos; capital, $10,000; treasurer, Coates Coleman, Swarthmore.

Catawissa: The Catawissa Knitting Mills; capital, $8,000; treasurer, C. P. Pfahler, Catawissa.

Scranton: The Diamond Oil and Paint Company, manufacturing paints and lubricating oils; capital, $100,000; treasurer, William F. McGee, 209 Colfax avenue, Scranton.

Philadelphia: F. A. Bochmann & Company, Incorporated; manufacturing all kinds of textiles; capital, $375,000; treasurer, Paul C. Bochmann, 153 West Seventy-ninth street, New York.

Allentown: The Griesemer Stationary Company; capital, $5,000; treasurer, Jacob P. Griesemer, Allentown.

Philadelphia: The Leblang-Gross Company, manufacturing lenses, optical instruments and goods; capital, $5,000; treasurer, Isaac Leblang, 3644 North Broad street, Philadelphia.

Erie: Lakeside Forge Company, manufacturing iron and steel forgings; capital, $100,000; treasurer, Frederick Bell McBrier, Erie.

Philadelphia: The Master Printer Publishing Company; capital, $5,000; treasurer, Warren B. Hart, Jr., 123 North Thirty-third street, Philadelphia.

Pittsburg: McCurdy Aeroplane Company, manufacturing aeroplanes; capital $5,000; treasurer, Arthur L. S. McCurdy, Hotel Astor, New York.

New Castle, Lawrence county: Rose Point Stone and Lime Company; capital, $50,000; treasurer, Matthew Gunton, New Castle.

Harrisburg: Sun Medical Company, manufacturing medicines; capital, $30,000; treasurer, Joseph R. Coleman, Harrisburg.

Beaver Falls: The United Games Concern, manufacturing games and toys; capital, $5,000; treasurer, Edward F. Fessenden, Beaver Falls.

Breezewood, Bedford county: McConnellsburg and Breezewood Telephone Company; capital, $15,000; treasurer, William C. Hanks, Clearfield.

Lancaster: New Process Steel Corporation, manufacturing flat, round, oval and specially designed bars, rods and tubes; capital, $50,000; treasurer, H. S. McClure, Lancaster.

Scranton: Pocono Distilling Company, capital, $50,000; treasurer, Max F. Henkelman, Scranton.

Wilkes-Barre: The Faust Lumber Company; capital, $5,000; treasurer, William B. Yeager, 110 Hanover street, Wilkes-Barre.

Chester: Robert E. Clark Thread Manufacturing Company; capital, $50,000; treasurer, Robert E. Clark, Chester.

Pittsburg: Keeling Coal Company, mining; capital, $5,000; treasurer, Eugene B. Strassburger, 345 Stratford avenue, Pittsburg.

New Castle: New Castle Peanut Company, manufacturing all kinds of confectionery; capital, $5,000; treasurer, Harry L. Allen, New Castle.

Bangor: Bangor Silk Knitting Company; capital, $5,000; treasurer, Philip Keenan, Bangor.

Plumstead township, Bucks county: Gardenville Dairymen's Association, manufacturing butter and cheese; capital, $5,000; treas, Alfred S. Tindall, Gardenville.

Boswell, Somerset county: Standard Quemahoning Coal Company, mining and drilling; capital, $100,000; treasurer, Frank Feese, Boswell.

Wilkes-Barre: Commercial Motor Car Company, manufacturing motor cars; capital, $25,000; treasurer, J. Wallace Davis, Wilkes-Barre.

Philadelphia: H. T. Smithurst Company, manufacturing covered and uncovered wires; capital, $5,000; treasurer, Seymour Slegman, 44 South Sixty-first street, Philadelphia.

Pittsburg: The June Oil and Gas Company; capital, $5,000; treasurer, J. Lee McKnight, 1765 Frick Building Annex, Pittsburg.

Pittsburg: Lang Broom Company; manufacturing brooms; capital, $25,000; treasurer, C. E. Willock, Edgewood.

Harrisburg: The Model Typewriter Company, manufacturing typewriters; capital, $5,000; treasurer, George H. Bruder, Harrisburg.

Johnstown: Smokeless Coal Company; capital, $60,000; treasurer, William R. Thomas, Johnstown.

Philadelphia: The Master Company, manufacturing cleansers and disinfectants; capital, $5,000; treasurer, Martin J. Ettinger, 1409 West Allegheny avenue, Philadelphia.

Bridgeville, Allegheny county: Montclair Manufacturing and Machine Company, Limited, manufacturing trolley wheels, pulleys and mechanical appliances; capital, $5,000; treasurer, H. W. Crouch, Bridgeville.

Manchester, York county: Manchester Hosiery Mills Company; capital, $10,000; treasurer, Ralph J. Hilliker, York.

Philadelphia: Bennett & Aspden Company, manufacturing pile fabrics; capital, $40,000; treasurer, Newton J. Aspden, 5405 North Fifth street, Philadelphia.

Shamokin: The Buck Ridge Coal Mining Company, mining coal and manufacturing coke; capital, $500,000; treasurer, Gardner Pattison, Beekman Terrace, Summit, N. J.

Philadelphia: The Continental Elderdown Company, manufacturing textile fabrics; capital, $25,000; treasurer, Stanley R. Stager, 1 Asbury Terrace, Oak Lane, Philadelphia.

New Brighton, Beaver county: Keystone China Company, manufacturing pottery; capital, $20,000; treasurer, James E. Whittaker, New Castle.

Beaver: Keystone Smokeless Coal Company; mining coal, limestone, clay, iron, oil or gas; capital, $15,000; treasurer, D. A. Nelson, Beaver.

Braddock, Allegheny county: Loew-Miller Company, manufacturing roofs, sheet metal, etc., capital, $10,000; treasurer, John A. Loew, Braddock.

Pittsburg: Union Grease and Oil Company, manufacturing oils, greases, compounds and other lubricants; capital, $5,000; treasurer, E. S. Gerwig, Pittsburg.

Mifflintown, Juniata county: Progressive Oil and Gas Company; mining and drilling for oil and gas; capital, $10,000; treasurer, J. Lloyd Hartman, Mifflintown.

Philadelphia: Dreifus & Co., Incorporated; manufacturing uniforms; capital, $20,000; treasurer, Abraham Dreifus, Philadelphia.

Philadelphia: The Krips-Wright Company, Incorporated, manufacturing serial cable carriers and other mechanical and electrical devices; capital, $30,000; treasurer, Arthur B. Sherrill, 246 Winona avenue,Philadelphia.

Pittsburg: The Montour Brick Company, mining coal and clay; capital, $40,000; treasurer, Thomas E. Wilson, California avenue, N. S., Pittsburg.

Glencoe, Somerset county: The Northampton Telephone Company: capital, $5,000; treasurer, G. H. Ellman, Glencoe.

Philadelphia: Oldsmobile Company of Pennsylvania; manufacturing motor vehicles; capital, $10,000; treasurer, Rupert E. Paris, Lansing, Mich.

Bradford: Tuna Iron and Steel Works, F. Hamilton, Incorporated; manufacturing steel and iron portable drilling machines, etc., capital, $50,000; treasurer, L. W. Barton, Bradford.

Harrisburg: Wear-U-Well Shoe Company, manufacturing shoes and boots, capital, $5,000; treasurer, B. C. Hommon, Columbus, O.

Philadelphia: Riegel & Company, Incorporated, manufacturing paper; capital, $30,000; treasurer, Arthur B. Sherrill, 246 Winona avenue, Philadelphia.

Renova: Renova Fire Brick and Clay Manufacturing Company; capital, $220,000; treasurer, Bernard Fischer, Philadelphia.

Scranton: Rissinger Brothers and Company, Incorporated, mining anthracite coal; capital, $25,000; treasurer, William W. Rissinger, 708 Monroe avenue, Scranton.

Allentown: Lehigh Brewing Company, manufacturing malt liquors; capital, $5,000; treasurer, H. B. Frederick, Catasauqua.

Ernest Station, Montgomery county: Eastern Range Boiler and Welding Company, manufacturing boilers and expansion tanks; capital, $100,000; treasurer, J. Edward Wentling, Conshohocken, Pa.

Waynesboro: D. L. Miller and Company, manufacturing drugs and chemicals; capital, $25,000; treasurer, D. L. Miller, Waynesboro.

Pittsburg: Universal Manufacturing Company, manufacturing machinery and apparatus for cleaning and renovating; capital, $5,000; treasurer, Paul C. Little, Carnegie.

Suter, Westmoreland county: Cordial Panna Company, manufacturing cordials; capital, $5,000; treasurer, Louis Casoli, Blythesdale, Allegheny county.

Pittsburg: Pittsburg Silica Sand and Brick Company, mining and quarrying silica sand and stone and manufacturing brick; capital, $5,000; treasurer, Wilbur M. Graham, Erie.

Pittsburg: Sanitary Store Fixture Company, manufacturing all kinds of furniture; capital, $5,000; treasurer, A. R. Albaugh, 1221 Farndale street, Pittsburg.

Slatington, Lehigh county: Slatington Rolling Mills; capital, $60,000; treasurer, Walter H. Andrews, Slatington.

Hazleton: Standard Vending Machine Company, manufacturing vending machines; capital, $5,000; treasurer, A. W. Drake, Hazleton.

Philadelphia: Philadelphia Pile Fabric Mills, manufacturing textile goods; capital, $100,000; treasurer, Isaac Wasserman, 1845 North Seventeenth street, Philadelphia.

East Pike Run township, Washington county: Lilly Coal and Coke Company; capital, $5,000; treasurer, John H. Moffitt, Charleroi.

Philadelphia: Tonogen Company manufacturing chemicals and drugs; capital, $25,000; treasurer, W. Clifford Hunter, St. Davids.

Philadelphia: Largman Skirt Manufacturing Company, manufacturing clothes; capital, $20,000; treasurer, Hyman Frank, 1311 North Marshall street, Philadelphia.

General

Muncy: The capital stock of the West Branch Bell Telephone Company has been increased from $10,000 to $50,000.

Pittsburg: Pittsburg-Westmoreland Coal Company has increased its indebtedness from $5,542,000 to $6,442,0000.

Reading: The directors of the Reading Hardware Company have increased their capital stock from $900,000 0to $1,700,000.

Allentown: The Loux Creamery Company has increased its stock from $25,000 to $50,000.

Lawrence county: The Enon Valley Telephone Company has increased its capital stock from $10,000 to $300,000.

Greensburg: The Dillinger Distilling Company has increased its capital from $10,000 to $300,000.

Watsontown: The Watsontown Brick and Clay Product Company has decided to increase its indebtedness from nothing to $30,000.

Scranton: The Pocket Umbrella Company has increased its capital stock from $10,000 to $125,000.

New York: The Colonial Iron Company has increased its capital from $200,000 to $300,000.

Berwick: Berwick Gas Company has increased its capital stock from $100,000 to $410,000, its indebtedness from nothing to $87,000.

Harrisburg: The Devine and Yungel Shoe Company has increased its indebtedness from nothing to $18,000.

West Chester: The American Road Machine Company has increased its capital from $250,000 to $1,000,000.

Lancaster: The Universal Hardware Works has increased its capital stock from $10,000 to $50,000.

Pittsburg: The Crucible Coal Company has decided to increase its debt from nothing to $1,000,000.

Philadelphia: The Bucks County Public Service Company has increased its bonded indebtedness from nothing to $200,000; its capital from $5,000 to $200,000.

Bethlehem: Lehigh Foundry Company has increased its indebtedness frm $98,000 to $100,000.

Harrisburg: The Model Typewriter Company has increased its indebtedness from nothing to $12,000.

Lebanon: Lebanon Valley Iron and Steel Company has increased its capital stock from $1,000,000 to $1,500,000.

Pittsburg: The Pittsburg Bridge and Iron Works has increased its capital from $100,000 to $200,000.

Luzerne county: The Farmers' Telephone and Supply Company has increased its capital from $10,000 to $25,000.

Pittsburg: United States Police and Fire Signal Company has increased its capital stock from $5,000 to $15,000.

Jefferson county: The Panther Run Coal Company has increased its capital from $35,000 to $167,000.

Wilkes-Barre: The Washington Silk Company has increased its indebtedness from nothing to $25,000.

Philadelphia: South Fork Coal Mining Company has authorized an increase in capital from $50,000 to $100,000.

LIGHT, HEAT AND POWER.

Charters

Coopersburg, Lehigh county: The Coopersburg Electric Light, Heat and Power Company; capital, $5,000; treasurer, R. D. Barron, Coopersburg.

Jersey Shore, Lycoming county: The Avis Gas Company; capital, $5,000; treasurer, A. Grant Richwine, Mechanicsburg.

Jersey Shore: The Avis Gas Fuel Company; capital, $5,000; treasurer, A. Grant Richwine.

Jersey Shore: The Porter Gas Company; capital, $5,000; treasurer, A. Grant Richwine, Mechanicsburg.

Jersey Shore: The Porter Gas Fuel Company; capital, $5,000; treasurer, A Grant Richwine, Mechanicsburg.

Nanty-Glo, Cambria county: Jackson Light, Heat and Power Company; capital, $5,000; treasurer, Thomas P. Burns, Nanty-Glo.

Lebanon: West Lebanon Electric Light and Power Company; capital, $5,000; treasurer, Daniel Weaver, Lebanon.

Ebensburg: Cambria Township Light, Heat and Power Company; capital, $5,000; treasurer, Walter Jones, Ebensburg.

Stroud township, Monroe county: Blackstone Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Rahn township, Schuylkill county: Eldon Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Schuylkill township, Schuylkill county: Fearne Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Ryan township, Schuylkill county: Gibson Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Smithfield township, Monroe county: Kent Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Blythe township, Schuylkill county: Marshall Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Mahonoy township, Schuylkill county: Mitchell Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Rush township, Schuylkill county: Sharwood Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

Norwegian township, Schuylkill county: Story Electric Company; capital, $10,000; treasurer, H. F. Baker, Germantown.

East Norwegian township, Schuylkill county: Taney Electric Company; capital, $10,000; H. F. Baker, Germantown.

Washington, Washington county: Amwell Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, 506 People's Building, Pittsburg.

Washington: Burgettstown Electric Company; capital, $5,000; treasurer, E. S. Wheeler, 506 People's Building, Pittsburg.

Oakdale, Allegheny county: Findley Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Canton Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Chartiers Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Canonsburg, Washington county: Canonsburg Union Electric Company, capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Cecil Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

East Waynesburg, Greene county: East Waynesburg Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: East Washington Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Waynesburg: Franklin Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Oakdale, Allegheny county: Findley Township Electric Company, capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Houston, Washington county: Houston Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Morris Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Oakdale, Allegheny county: North Fayette Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: North Strabane Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: North Franklin Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Oakdale, Allegheny county: Oak Borough Electric Company, capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Pleasant Valley Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Robinson Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Oakdale, Allegheny county: South Fayette Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: South Franklin Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: South Strabane Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Smith Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Waynesburg: Washington Township Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Washington: Washington Union Electric Company; capital, $5,000; treasurer, E. S. Wheeler, Pittsburg.

Mahanoy City: The United Light, Heat and Power Company, of Mahanoy City; capital, $5,000; treasurer, Patrick V. Dunn, Shenandoah.

Pittsburg: Menallen Electric Company, Fayette county; capital, $5,000; treasurer, William H. Larimer, Wilkinsburg.

Oil City: The Hopewell Oil and Gas Company, mining and drilling, capital, $25,000; treasurer, William B. James, Oil City.

Ebensburg: Allegheny Light, Heat and Power Company; capital, $5,000; treasurer, James Collins Jones, 1531 North Fifteenth street, Philadelphia.

Ebensburg: Blacklick Light, Heat and Power Company; capital, $5,000; treasurer, James Collins Jones, Philadelphia.

Ebensburg: Cresson Light, Heat and Power Company; capital, $5,000; treasurer, James Collins Jones, Philadelphia.

Ebensburg: Gallitzen Light, Heat and Power Company; capital, $5,000; treasurer, James Collins Jones, Philadelphia.

Ebensburg: Summer Hill Light, Heat and Power Company; capital, $5,000; treasurer, James Collins Jones, Philadelphia.

Ebensburg: Pioneer Light, Heat and Power Company, capital, $5,000; treasurer, James Collins Jones, Philadelphia.

Ebensburg: Washington Light, Heat and Power Company; capital, $5,000; treasurer, James Collins Jones, Philadelphia.

New Brighton, Beaver county: College Hill Electric Company; capital, $30,000; treasurer, Julius Theobald, New Brighton.

Plymouth: Consumers' Light Company, of Plymouth; capital, $5,000; treasurer, Thomas J. Connelly, Wilkes-Barre.

Newmanstown, Lebanon county: Denver Electric Light and Power Company; capital, $5,000; treasurer, D. S. Martin, Bellevue.

Moosic, Lackawanna county: Moosic Electric Company; capital, $5,000; treasurer, Duncan T. Campbell, Scranton.

Newmanstown: West Cocalico Electric Light and Power Company; capital, $5,000; treasurer, D. S. Martin, Bellevue.

Philadelphia: Offset Process Company, creating and purchasing patent rights for inventions; capital, $10,000; treasurer Robert N. Fell, Ogontz.

Saucon township, Northampton county: Saucon Electric Light, Heat and Power Company; capital, $5,000; treasurer, H. M. Neberroth, South Bethlehem.

Harrisburg: Harrisburg Electric Service Company; capital, $5,000; treasurer, John F. Sweeney, Harrisburg.

Newton, Bucks county: Bucks County Gas and Fuel Company; capital, $5,000; treasurer, William Knemmerle, Jr., Real Estate Trust Building, Philadelphia.

Ebensburg, Cambria county: Croyle Light, Heat and Power Company; capital, $5,000; treasurer James Collins Jones, 1531 North Fifteenth street, Philadelphia.

Ebensburg: Jackson Township Light, Heat and Power Company; capital, $5,000; treasurer, James Collins Jones, Philadelphia.

RAILWAYS.

Proposals

Lebanon: Proposals will be received at the office of the Lebanon and Campbellstown Street Railway Company at the Hershey Trust Company building, Hershey, at 6 o'clock, on the evening of August

17 for the construction of the roadbed and track of nine and one-fourth miles of railway, extending from Campbellstown to Twelfth street, Lebanon; all materials, except masonry, will be furnished by the company.

Philadelphia: The Philadelphia Railway has increased its indebtedness from nothing to $400,000.

Erie: The Erie and Suburban Railway Company has authorized an increase in its indebtedness from nothing to $600,000, its capital from $10,000 to $300,000.

Lehigh county: The Crane Railroad Company has increased its capital stock from $100,000 to $250,000.

Latrobe: The Mt. Pleasant and Latrobe Railroad Company has filed a decree of dissolution.

Pittsburg: The Cleveland and Pittsburg Railroad Company has increased its capital stock from $22,000,000 to $40,000,000.

Tarentum: The Tarentum, Brackenridge and Butler street Railway Company will make an extension to its lines.

Altoona: The Altoona and Logan Valley Electric Railway Company has decided to make extensions this summer.

Scranton: The Scranton and Lake Ariel Railway Company will extend its lines this year.

Pittsburg: The Duquesne and Dravosburg Street Railway Company has increased its capital from $18,000to $60,000; its indebtedness from nothing to $60,000.

Tarentum: The Tarentum, Brackenridge and Butler Street Railway has increased its indebtedness from nothing to $150,000.

McKean county: The Kinzua Valley and Kinzua Railway Company has merged under the name of the Kinzue Railroad, and the McKean and Buffalo Railroad has merged with the New York and Pennsylvania Railroad.

SEWERAGE.

Permits

Harrisburg: State Health Commissioner Dixon has issued this city a permit for the construction of the river front marginal sewer and has approved the general plan for sanitary sewers. The people in 1910 voted $316,000 for the marginal interceptor and $100,000 for the sanitary sewers. A third item in the loan is $100,000 for the improvement of Paxton creek and the plans for this must be submitted to Dr. Dixon for approval. In the decree of Dr. Dixon, which covers the whole sewage situation in Harrisburg, the Health Commissioner fixes January 1, 1915, as the time when plans must be completed for a sewage disposal plant which will be located on Redbud Island in the Susquehanna river. The preliminary plans for this plant have been returned to the City Engineer for further study. At the present time the city has not provided the money for this work.

It is suggested by Dr. Dixon that Steelton, Enola and other towns in the vicinity of Harrisburg co-operate with this city in the sewage disposal question, as all sewage must be eliminated from the State's streams by January 1, 1915. The continued use of sewers for sewage and drain water is discountenanced and a complete system of sanitary sewers, costing at the outside, $654,400 is recommended. Plans are now drawn for 98.1 miles of sanitary sewers; 22.7 miles of combined sewers and there are now in use 41.6 miles of combined sewers. Bids for the marginal sewer were opened on July 30 by the Board of Public Works and William H. Opperman & Company, of Harrisburg, was the lowest bidder out of ten. Councils subsequently awarded the contract to this firm. The bids were as follows:

William H. Opperman & Company, Harrisburg, 77,841.05; Stucker Bros.' Construction Company, Harrisburg, $95,471.10; United Ice and Coal Company, Harrisburg, $96,276.60; Ryan & Ryan, Philadelphia, $101,651.90; William S. Miller, Harrisburg, $104,397.88; W.

H. & C. F. Thompson, Baltimore, $111,965; J. E. Bunting, New York, $156,550.50; Forschner & Sexton, New York, $126,283.90; James Ferry & Sons, Pittsburg, $141,705; S. Pearson & Son, New York, $219,889.60.

Owing to the decree of Dr. Dixon additional manholes must be provided along the marginal interceptor and the concrete portion of the sewer must be waterproofed. This may run the contract price of the sewer up to $100,000, thus leaving $216,000. Plans are now being considered for the construction of a protection wall along the river bank.

Charters

Perkasie, Bucks county: Perkasie Sewer Company, constructing public sewers; capital, $25,000; treasurer, Philip S. Cressman, Perkasie.

General

Danville, Montour county: This borough will build this summer a sewer system. Plans for a comprehensive sewerage system were prepared by Engineer Collins, of Philadelphia, and they have been adopted by the State Health Department.

Sunbury, Northumberland county: This borough is partly provided with sewers, owned by several companies. It may be necessary to consolidate these companies in order to carry out the State's orders for sewage treatment. The East End Sewage Company desires to extend its system: E. J. Purdy is the secretary.

Gilberton, Schuylkill county: It has been decided that this town must employ an engineer to lay out a comprehensive sewage plant.

Middletown: The Middletown Drainage Company has engaged a local engineer to prepare plans for a comprehensive sewer system for the borough and for treating sewerage on an island opposite the town, so located that Royalton and Highspire can use the disposal plant.

Newcastle: Land has been purchased in the Beaver river for the construction of a sewage disposal plant; C. H. Millholland is the engineer in charge.

Cresson: The State Tuberculosis Sanitorium will construct, at the direction of the State Health Department, a system of sewers and a disposal plant this year. The work will be let by contract.

Woodville, Allegheny county: The Directors of the Poor will build sewers and a disposal plant at the county home and the hospital for the insane here.

Myersdale, Somerset county: The Department of Health has directed this borough to build a comprehensive sewer system and a disposal plant.

Renova, Clinton county: Plans for a sewer system for this place are being prepared. The town must keep its sewage out of the Susquehanna river.

Erie: The Erie Improvement Company is making preparations for a large town in Mill Creek township, Erie county, adjacent to this city. The Pennsylvania General Electric Company is erecting its new plant near this development and the improvement company is building sewers and laying out streets.

Palmerton, Carbon county: The Palmer Land Company is extending its sewers and preparing for a disposal plant.

Ben Avon Heights, Allegheny county: The Ben Avon Heights Sewer Company may build a sewer system and a sewage disposal plant.

Mont Alto: Bids for the extension of the sewage disposal plants will shortly be advertised for, and the work will be completed this year.

STREETS AND HIGHWAYS

Proposals

Harrisburg: Bids have been asked by State Highway Commissioner Bigelow for the construction of the State road through the famous Lewistown Narrows. Proposals will be made on two stretches of highway, approximating ten miles and they must be submitted to the State Highway Department not later than 2 o'clock on the afternoon of August 23. The first stretch calls for 22,560 feet of road extending from the Mifflin-Juniata county line to the west borough line of Lewistown, while the second provides for 34,793 feet, extending from the same county line to the east borough line of Mifflintown

These are the first bids asked under the reorganized Highway Department and the roads mentioned will be the first to be constructed under the new Sproul main highway bill. Other bids will be asked shortly. Commissioner Hunter has sent out fourteen engineers, each with a corps under him, to survey the State's most important roads and a vigorous campaign will be carried on all summer. Among the first roads to be constructed after the Lewistown-Mifflintown highway will be the Harrisburg-Gettysburg route and then probably will come the Harrisburg-Fort Hunter road, which was surveyed a year ago; work on this road to Sunbury is now being pushed forward by the engineers. By August 1 there will be about forty corps working in different parts of the State. Contracts made under the old laws will hold good and some roads selected last year for improvement are now being built.

WATER SUPPLY.

General

Harrisburg: The Water Supply Commission of Pennsylvania, after careful hearing and consideration of the application of the Evitts Creek Water Company, of Bedford, held the matter under advisement. Col. G. H. Pearre, of Cumberland, Md., representing the protestants, appeared and argued that the application should not be granted for the reason that the statement of purpose showed that it was the intention to supply water to the public in the township of Cumberland Valley, Bedford county, Penna., whereas the real purpose was to supply water to the public in the city of Cumberland, state of Maryland. Messrs. Young, Sloan, Footer, Soll and Mauk appeared in the interest of the application and urged its approval.

A hearing was held on the complaint of the citizens of Shickshinny against the inadequate service given by the Shickshinny Water Company in said borough, and the matter was referred to the Attorney General with the recommendation that he institute quo warranto proceedings against the said company.

The application for the incorporation of the Ross Township Water Company, for the supply of water to the public in the township of Ross, Luzerne county, was disapproved.

The following applications were considered and held under advisement: Hop Bottom Water Company, for the supply of water to the public in the Borough of Hop Bottom, Susquehanna county.

Weavertown Water Company, for the supply of water to the public in the township of North Lebanon, Lebanon county.

The application of Mr. J. E. Forney, of Williamsport, Penna., for the construction of a skating rink on the south bank of the West Branch of the Susquehanna river at Williamsport, Penna., was approved.

Danville: The trustees of the State Insane Hospital will build a $20,000 new storage reservoir in connection with its water storage plant.

Muncy, Lycoming county: This municipality has been notified to boil all water used by the State Department of Health until a water filtering plant is installed.

Pottsville: The Penn Land Company settlement in Norwegian township, nearby, is planning a water works system.

Lancaster: This city is required by the State Department of Health to extend and improve its water filter plant, owned by the Lancaster Filter Company, 112 North Broad street, Philadelphia.

Lancaster: A high district pumping plant is being built by this city. F. H. Shaw is the superintendent of the water works.

Lock Haven, Clinton county: This town will improve its municipal water works system by constructing an impounding reservoir on the mountain side.

Jersey Shore, Lycoming county: The Jersey Shore Water Company is building a new pumping station and next season will erect a large impounding reservoir.

Phoenixville, Chester county: Plans have been approved for the hypochloride treatment plant connected with the municipal water works and the pipes will be extended into the adjoining townships.

Port Allegheny, McKean county: The water system here will be extended; wells will be drilled and a pumping station erected in connection with a gravity supply.

Port Royal, Juniata county: The Port Royal Water Company will extend its system in the borough.

Coppel borough, Beaver county: The Coppel Water Company will build a water works system and the question of sewers and sewage disposal for the borough will soon come up.

Myersdale: The Sand Spring Water Company of this place must abandon the use of Blue Lick creek as a source of water supply or erect a filter plant.

Gravel Hill: The Gravel Hill Water Company has filed notice of an increase of its indebtedness from nothing to $200,000.

Johnstown: The Johnstown Water Company has increased its indebtedness from $210,000 to $1,500,000.

Benton, Columbia county: The Benton Water Company has increased its capital from $1,000 to $10,000; its indebtedness from nothing to $30,000.

Brownsville, Fayette county: The Brownsville Water Company has authorized an increase of capital stock from $60,000 to $90,000.

Clarion: The Clarion Water Company has awarded the contract for the steel settling tank to the Hammond Iron Works, of Warren, Pa. Chester & Fleming, Union Bank Building, Pittsburg, are Consulting Engineers for this work.

East Liverpool, O.: East Liverpool has employed the firm of Chester & Fleming, Engineers, Union Bank Building, Pittsburg, to prepare plans and specifications for the installation of a well supply for the city. It is probable that fifteen or twenty 12 foot wells, 30 feet deep, will be drilled along the river front at the upper end of the city.

Wernersville: The contract has been formally awarded by the Commonwealth of Pennsylvania to the Pitt Construction Company, of Pittsburg, for constructing a 300,000 gallon water filtration plant, half million gallon reinforced concrete covered reservoir, settling basin and appurtenances for water works for the State Asylum for Chronic Insane at Wernersville, in accordance with plans and specifications prepared by Chester & Fleming, Consulting Engineers,Union Bank Building, Pittsburg, Pa.

Engineers' Society of Pennsylvania

THIRD SERIES. SEPTEMBER, 1911 No. 9.

MONTHLY BULLETIN

ENGINEERING WORK PROPOSED

In this column is published each month news relating to proposed engineering work in Pennsylvania, as far as such information is obtainable. This service will be useful to contractors and the trade in Builders' Supplies. The items of interest embrace engineering constructive work of all kinds and degrees of magnitude. Send in the notes to Chas. G. Miller, Editorial Staff, on or before the first day of each month.

BUILDINGS.

Charters

Philadelphia: Allegheny Amusement Company, constructing theatres and other buildings; capital, $5,000; treasurer, Joseph Cohen, 2032 East Birch street, Philadelphia.

Scranton: Wayne Development Company, constructing dams and reservoirs; capital, $5,000; treasurer, Frederick W. Stillwell, Scranton.

Harrisburg: The United Gas Construction Company, general contractors; capital, $5,000; treasurer, John C. Wensell, Harrisburg.

Pittsburg: Pittsburg Pipe Line Construction Company, constructing pipe lines for oil, gas and water; capital, $10,000; treasurer, N. A. Sutton, Steubenville, O.

INDUSTRIAL.

Charters

Philadelphia: The Automobile Service Association, manufacturing automobiles and motor vehicles; capital, $15,000; treasurer, Harry V. Elliott, Seventeenth street and Lehigh avenue, Philadelphia.

Scranton: A. W. Schrader Company, manufacturing malt extracts; capital, $100,000; treasurer, Ignantz Imeldopf, Scranton.

Exeter, Luzerne county: The Exeter Lumber Company, manufacturing lumber; capital, $10,000; treasurer, Frederick J. Yates, West Pittston.

Harrisburg: The New Idea Hosiery Company, manufacturing knit goods; capital, $5,000; treasurer, John H. Landis, Harrisburg.

Pittsburg: Large Motor Truck Company, manufacturing self-propelled vehicles; capital, $25,000; treasurer, Edwin L. Atkinson, 932 Mellon street, Pittsburg.

Bangor, Northampton county: Venus Silk Glove Manufacturing Company; capital, $10,000; treasurer, J. E. Wunsch, Jersey City, N. J.

Bradford, McKean county: Youngsville Brick and Tile Company; capital, $60,000; treasurer, George W. Foster, Main street, Bradford.

Port Allegany, McKean county: Port Allegany Furniture Works; capital, $25,000; treasurer, M. L. App, Port Allegany.

Warren: Schellhammer & Company, manufacturing heating and ventilating systems and devices; capital, $15,000; treasurer, Ella A. Cochener, Warren.

Philadelphia: Schandein and Lind Company, manufacturing perfumery and toilet articles; capital, $75,000; treasurer, Monroe P. Lind, 1723 Tioga street, Philadelphia.

Rockland township, Venango county: Shaffer Highgrade Lime Company, mining lime stone; capital, $5,000; treasurer, H. L. Shaffer, Venango county.

Philipsburg, Centre county: The Spaide and Stauffer Company, manufacturing articles of wearing apparel; capital, $30,000; treasurer, R. B. Stauffer, Philipsburg.

Philadelphia: The Frankel-Hayes Company, manufacturing bats; capital, $5,000; treasurer, Armin A. Frankel, 1918 East Dauphin street, Philadelphia.

Pittsburgh: A. Stucki Company, manufacturing iron and steel; capital, $5,000; treasurer, A. Stucki, Pittsburgh.

West Berwick, Columbia county: Gawenda-Marko Manufacturing Company, manufacturing machinery of all kinds; capital, $5,000; treasurer, John Marshay, West Berwick.

Shinglehouse, Potter county: Wolcott Gas Company, operating for petroleum oil and natural gas; capital, $110,000; treasurer, G. B. Scott, Shinglehouse.

Pittsburgh: The Hand Vacuum Sweeper Company, manufacturing cleaners and sweepers; capital, $10,000; treasurer, Henry J. Thomas, 7211 Upland street, Pittsburgh.

Philadelphia: Harvey R. Pierce Company, manufacturing surgical instruments; capital, $25,000; treasurer, Gustave A. Gussmann, 1435 North Seventeenth street, Philadelphia.

Philadelphia: Isaac Lockhart and Sons, manufacturing carpets; capital, $35,000; treasurer, Andrew Lockhart, 3745 North Gratz street, Philadelphia.

Pittsburgh: Mutual Wind Shield Manufacturing Company, manufacturing motor vehicles, motor boats and aeroplanes; capital, $12,000; treasurer, George F. Ferrier, 313 Gross street, Pittsburgh.

Pittsburgh: The Stevenson Company, manufacturing electrical machinery; capital, $6,000; treasurer, William D. Stevenson, 1221 Westinghouse building, Pittsburgh.

Philadelphia: Wylam Manufacturing Company, manufacturing tags, labels and paper articles; capital, $25,000; treasurer, V. Winfield Challenger, 5710 American street, Philadelphia.

Philadelphia: Earl Manufacturing Company, manufacturing mechanical vibrators; capital, $10,000; treasurer, Edward E. Ziegler, 4333 Germantown avenue, Philadelphia.

Philadelphia: Tuck Cigar Company, manufacturing cigars, cigarettes and tobacco; capital, $10,000; treasurer, Jesse E. Groves, 216 North Fifty-third street, Philadelphia.

Pittsburgh: Carbon Steel Company, manufacturing iron and steel; capital, $5,000; treasurer, Fred C. Shobert, Oliver building, Pittsburgh.

Pittsburgh: Neville Concrete Company, manufacturing structural materials for building purposes; capital, $50,000; treasurer, Edward M. Seibert, 22 North Fairmont street, Pittsburgh.

Pittsburgh: The Zemmer Company, manufacturing chemical and medical preparations; capital, $50,000; treasurer, C. C. Doll, Pittsburgh.

Pittsburgh: Case Crane Company of Pittsburgh, manufacturing iron and steel and of cranes; capital, $5,000; treasurer, Charles P. Carpenter, Sixteenth and Wood streets, Pittsburg.

Bradford: Metallic Alloys Company, manufacturing bearings; capital, $10,000; treasurer, W. C. Leary, Bradford.

Philadelphia: Woodward-Wanger Company, manufacturing brass goods and machinery; capital, $50,000; treasurer, George W. F. Keys, 1829 Pacific street, Philadelphia.

Reading: Harwood and Von Rohl Piano and Player Piano Company, capital, $50,000; treasurer, Edward F. Harwood, Reading.

Allentown: Lehigh Mills Company, manufacturing knit goods; capital, $5,000; treasurer, John A. Keppelman, Reading.

Reading: Premier Underwear Company, manufacturing knit goods; capital, $10,000; treasurer, Harry A. Coxe, 546 North Front street, Reading.

Harrisburg: Callister Manufacturing Company, manufacturing mechanical devices; capital, $5,000; treasurer, Dickinson McAllister, Harrisburg.

Harrisburg: Harrisburg Bag and Box Company; capital, $25,000; treasurer, S. P. Eby, Harrisburg.

Pittsburgh: Logan Drug and Bitters Company, manufacturing chemicals; capital, $15,000; treasurer, John W. Landser, Mt. Oliver.

Reading: The Reading Towel Manufacturing Company; capital, $15,000; treasurer, James R. Giebel, 314 North Fourth street, Reading.

New Castle: The Triumph Bed Spring Company, manufacturing bed springs and house furnishings; capital, $10,000; treasurer, A. G. Zahnizer, New Castle.

Benton, Columbia county: Benton Roller Mills, manufacturing flour and feed; capital, $20,000; treasurer, John J. Mather, Benton.

East Greenville, Montgomery county: East Greenville Manufacturing Company, manufacturing washing machines and household goods; capital, $60,000; treasurer, Francis S. Schelley, East Greenville.

Philadelphia: H. Cramer, Incorporated, manufacturing clothing; capital, $30,000; treasurer, Israel Brod, 1835 Erie avenue, Philadelphia.

Philadelphia: Petry-Cassidy, Incorporated, manufacturing automobiles; capital, $10,000; treasurer, Edward A. Cassidy, Delmar apartments, Germantown.

Great Bend, Susquehanna county: Demer Brothers Company, manufacturing cut glass; capital, $25,000; treasurer, Philip J. Demer, Hallstead.

Conshohocken: Conshohocken Ice Company, manufacturing ice; capital, $5,000; treasurer, Julian P. Wright, 112 North Broad street, Philadelphia.

Philadelphia: G. F. Shuster Company, manufacturing shoes; capital, $25,000; treasurer, William S. Rendell, Mt. Holly, N. J.

Warren: Pickett Hardware Company, manufacturing iron or steel and furnaces, iron vats, etc.; capital, $100,000; treasurer, Louis Brown, 215 Water street, Pittsburgh.

Mt. Pleasant township, Westmoreland county: Pittsburgh Gas Stove and Manufacturing Company; capital, $5,000; treasurer, Edward J. Daschbach, 54 Carrick avenue, Carrick.

Spring City, Chester county: Pennsylvania Stove and Range Company, manufacturing stoves, heaters and furnaces; capital, $150,000; treasurer, William P. Miles, Spring City.

Kane: Berry Oil and Gas Company, drilling for oil and natural gas; capital, $25,000; treasurer, W. A. Wray, Tylersburg.

Du Bois, Clearfield county: Cramer Quarry Company, mining for sandstone, limestone and fire clay; capital, $20,000; treasurer, John C. Arnold, Du Bois.

Philadelphia: The J. M. Shock Absorber Company, manufacturing shock absorbers for automobiles and other vehicles; capital, $5,000; treasurer, Camille A. Contal, 6 avenue de Magenta, Saint Cloud, France.

Philadelphia: Philadelphia Truck Company, manufacturing automobiles and other vehicles; capital, $10,000; treasurer, Roger W. Griswold, Twenty-second and Chestnut streets, Philadelphia.

Emaus, Lehigh county: Excelsior Silk Company, manufacturing silk; capital, $50,000; treasurer, Ernest J. Stansfield, Emaus.

Monaca, Beaver county: Gooch Koehler Specialty Manufacturing Company, manufacturing machines and tools; capital, $5,000; treasurer, Paulus E. Koehler, Monaca.

Pittston: McCauley Coal Company, mining coal; capital, $25,000; treasurer, William H. McCauley, Wyoming.

Pittsburgh: Sharp, Schmunk and Lytle, Incorporated, manufacturing cigars; capital, $5,000; treasurer, G. H. Schmunk, 400 East North avenue, Pittsburgh.

Pittsburgh: Vogel-Fischer Oil and Gas Company, mining and boring for oil and gas; capital, $5,000; treasurer, Charles B. Fischer, 2916 Carson street, Pittsburgh.

Du Bois, Clearfield county: Bohemian Art Pottery Company, manufacturing pottery, fire brick, tile, sewer pipe, etc.; capital, $25,000; treasurer, M. I. McCreight, Du Bois.

Monessen: Pennsylvania Can Lock Company, manufacturing cans and locks; capital, $25,000; treasurer, Michael Heynik, Monessen.

General

Greenville: The Greenville Metal Products Company has increased its capital stock from $50,000 to $100,000.

Easton: The Rinek Cordage Company has authorized an increase in its indebtedness from nothing to $80,000.

Pittsburgh: The Pittsburgh Automobile Company has decreased its capital stock from $50,000 to $10,000.

Pittsburgh: The Universal Manufacturing Company has increased its capital from $5,000 to $250,000.

Pittsburgh: The directors of the Journal Box Lifting Company have increased the corporation's capital from $5,000 to $20,000.

Pittsburgh: The Grant Boulevard Petroleum Company has increased its indebtedness from nothing to $1,600.

Lancaster: National Scales Corporation has decreased its capital from $125,000 to $75,000.

Pittsburgh: The Pittsburgh Tube Company has increased its capital from $100,000 to $125,000.

Philadelphia: The Quaker City Iron Works has increased its bonded indebtedness from nothing to $10,000.

Harrisburg: The Harrisburg Electric Service Company has increased its capital from $5,000 to $2,000,000.

Pittsburgh: Union Auto Specialty Company has increased its capital from $10,000 to $75,000.

Smithton: The Smithton Light, Heat and Power Company has increased its indebtedness from nothing to $15,000.

Erie: The capital stock of the Heisler Locomotive Works has been increased from $150,000 to $200,000.

Renova: The Renova Fire Brick and Clay Manufacturing Company has increased its indebtedness from nothing to $60,000.

Philadelphia: The Automobile Service Association has increased its capital from $15,000 to $50,000.

Altoona: The Mausoleum Builders of Pennsylvania have increased their capital stock from $50,000 to $500,000.

Pittsburgh: The Zug Iron and Steel Company has increased its indebtedness from nothing to $280,000.

Meadville: The Meadville Lumber Manufacturing Company has increased its capital from $10,000 to $40,000.

Philadelphia: The Lockwood Folding Box Company has increased its stock from $5,000 to $25,000.

Monessen: The Motz Lumber Company has increased its capital from $50,000 to $100,000.

Philadelphia: The Pittsburgh and Susquehanna Coal Company has increased its capital from $5,000 to $500,000; its indebtedness from nothing to $500,000.

Berwick: Berwick Lumber and Supply Company has increased its indebtedness from $10,000 to $45,000.

West Pittston: The Clear Spring Coal Company has decreased its capital from $320,000 to $32,000.

Pittsburgh: The Allegheny Steel Company has increased its capital from $3,000,000 to $3,500,000.

Allentown: The Allentown Flint Bottle Company has increased its capital from $20,000 to $60,000.

Williamsport: The Keytsone Plaster Company has increased its indebtedness from $15,000 to $65,000; its capital from $200,000 to $250,000.

Reading: The Reading Bone Fertilizer Company has increased its capital from $100,000 to $200,000.

Bethlehem: The Bethlehem Foundry and Machine Company has increased its capital from $50,000 to $185,000; its indebtedness from $40,000 to $175,000.

Wilkes-Barre: The Morris Run Coal Mining Company has increased its stock from $890,500 to $950,500.

McKean: The National Chemical Company has increased its capital from $80,000 to $200,000.

Lancaster: The United States Asbestos Company has increased its capital from $60,000 to $105,300.

Williamsport: The National Foundry Manufacturing Company has increased its capital from $15,000 to $50,000.

Pittsburgh: The Pittsburgh and Eeastern Coal Company has increased its capital from $1,000 to $1,000,000.

Philadelphia: The Roxford Knitting Company has increased its indebtedness from nothing to $200,000.

Meadville: The Meadville Lumber Manufacturing Company has increased its capital from $10,000 to $40,000.

Somerset: The Standard Quemahoning Coal Company has increased its indebtedness from $23,999.99 to $47,999.99.

Philadelphia: The Baldwin Locomotive Works has increased its capital from $50,000 to $40,000,000.

Pittsburgh: The Bessemer Coke Company has decided to increase its indebtedness from $305,000 to $425,000.

LIGHT, HEAT AND POWER.

Charters

Fountain Hill, Lehigh county: Fountain Hill Electric Light, Heat and Power Company; capital, $5,000; treasurer, H. M. Ueberroth, South Bethlehem.

Bethlehem: The Moravia Electric Light, Heat and Power Company; capital, $5,000; treasurer, H. M. Ueberroth, South Bethlehem.

Northampton Heights, Northampton county: Northampton Heights Light, Heat and Power Company; capital, $5,000; treasurer, H. M. Ueberroth, South Bethlehem.

Pittston: Piedmont Electric Company; capital, $5,000; treasurer, J. A. McMillan, West Pittston.

Enola: Enola Gas Company, gas for light only; capital, $5,000; treasurer, Oscar L. Eppinger, Steelton.

South Bethlehem: South Bethlehem Light, Heat and Fuel Company; capital, $5,000; treasurer, Henry T. Duke, 510 North Thirty-ninth street, Philadelphia.

East Donegal Township, Lancaster county: East Donegal Township Electric Light Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

East Hempfield Township, Lancaster county: East Hempfield Township Electric Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

East Lampeter Township, Lancaster county: East Lampeter Electric Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

Lancaster Township, Lancaster county: Lancaster Township Electric Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

Manheim Township, Lancaster county: Manheim Township Electric

Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

Manor township, Lancaster county: Manor Township Electric Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

Mount Joy township, Lancaster county: Mount Joy Township Electric Light Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

Mountville, Lancaster county: Mountville Electric Light Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

Penn township, Lancaster county: Penn Township Electric Light Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

Rapho Township, Lancaster county: Rapho Township Electric Light Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

Warwick township, Lancaster county: Warwick Township Electric Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

West Lampeter township, Lancaster county: West Lampeter Township Electric Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

West Donegal township, Lancaster county: West Donegal Township Electric Light Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

West Hempfield township, Lancaster county: West Hempfield Township Electric Company; capital, $5,000; treasurer, John S. Graybill, Jr., Lancaster.

Pittsburgh: Freeport Electric Power Company; capital, $5,000; treasurer, W. B. Wallis, 17 South Emily street, Crafton.

Taylor, Lackawanna county: Taylor Electric Company; capital, $5,000; treasurer, Duncan I. Campbell, Scranton.

Gettysburg: Conewago Township Electric Light, Heat and Power Company; capital, $5,000; treasurer, Ellis S. Lewis, York.

Gettysburg: McSherrystown Electric Light, Heat and Power Company; capital, $5,000; treasurer, Ellis S. Lewis, York.

Gettysburg: New Oxford Electric Light, Heat and Power Company; capital, $5,000; treasurer, Ellis S. Lewis, York.

Newport: Perry Gas Company, for light only; capital, $5,000; treasurer, Oscar L. Eppinger, Steelton.

Norristown: Trappe Electric Company; capital $5,000; treasurer, Herbert H. Ganser, Norristown.

Altoona: Altoona Gas Light and Fuel Company; capital, $5,000; treasurer, Ralph W. Mott, 2031 East Chelten avenue, Philadelphia.

General

Gallitzin: The Gallitzin Light, Heat and Power Company has sold its franchise to the Penn Central Light and Power Company.

Cresson: The franchise of the Cresson Light, Heat and Power Company has been purchased by the Penn Central Light and Power Company which company has bought in the Vroyle Light, Heat and Power Company, the Blacklice Light, Heat and Power Company, and the Allegheny Light, Heat and Power Company.

RAILROADS.

Charters

Lebanon: A charter has been granted to the Lebanon and Campbellstown Street Railway Company with M. S. Hershey, of Hershey, president and holder of 1,160 of the 1,200 shares. The capital stock is $60,000.

Beaver: The Beaver Valley Street Railway Company will make an extension of its tracks this fall.

Aspinwall: The Aspinwall Street Railway Company has decided to extend its lines.

Berwick: An extension of the lines of the Berwick and Nescopeck

Street Railway Company has been agreed upon by the directors of the company.

Harrisburg: The Schuylkill and Dauphin Traction Company has authorized an increase of its capital stock from $25,000 to $75,000.

Lancaster: The indebtedness of the Lancaster and Southern Street Railway Company has been increased from nothing to $225,000.

Jersey Shore: The Jersey Shore Electric Street Railway Company has increased its capital from $25,000 to $135,000.

SEWERAGE.

General

Verona, Allegheny county: Verona will lay sewers this fall in most of the unsewered portions of the town.

Parson, Luzerne county: A sewage system, built along approved sanitary lines, will be constructed at once, covering the entire place.

Ambler, Montgomery county: This place is in need of sewers and the agitation for the construction of a sanitary sewage system has been going on here for the past two or three years. There is much talk of employing an engineer to draw plans for a system.

Everson, Fayette county: Everson, a suburb of Scottdale, will lay sewers late this fall or early in the spring. The plans for the system have been approved by the State Department of Health and Engineer J. B. Hogg, of Connellsville is in charge of the work.

Port Royal: Some of the citizens of this place have formed an association and raised funds under which the borough purposes to extend its sewage system. Up to the present time no engineer has been employed.

Connellsville: Chester & Fleming, consulting engineers of Pittsburgh, have been called into consultation by J. B. Hogg, City Engineer of Connellsville, with reference to preparing plans for a sewerage disposal plant for the borough of Connellsville.

STREETS AND ROADS.

Awards

Harrisburg: State Highway Commissioner Bigelow on September 15 opened bids for two sections of the Lewistown-Mifflin state highway and three sections of the National pike in Fayette and Somerset counties. It was the second opening of bids for the Lewistown road, the first having been received on August 23 and having been found too high. The second receipt of bids cuts down the first figures by about $30,000.

The lowest bidder for the two sections of the Lewistown road was C. J. Carothers, of Greensburg, who bid $111,499.25 for the Juniata county end of the road and $97,119.18 for the Mifflin county end of the highway. Reed and Patton, of Curwensville, was the lowest bidder on two sections of the National pike, bidding $67,458 and $46,429.28, while Charles T. Eastburn, of Yardley, was the lowest on the third section, his figures being $41,372.72. The detailed bidding on these five sections of road, which will be the first to be constructed under the Sproul main highway act, was as follows:

Juniata county, Fermanagh township:

W. C. Evans, Ambler,	$14,157 55
J. E. Francis, Punxsutawney,	124,668 72
W. E. Hawley, Pittsburgh,	134,716 80
C. J. Carothers, Greensburg,	111,499 25
Filbert Paving and Construction Company, Philadelphia,	155,105 89
	149,539 03
	136,601 37

D. E. Sullivan & Sons, Columbus, Ohio,	127,508 45
John McMenamy, Philadelphia,	154,787 64
	143,653 92
S. Pearson & Sons, Incorporated, New York,	137,287 25
United Ice and Coal Company, Harrisburg,	122,477 75

Mifflin county, Derry township:

W. C. Evans, Ambler,	$132,020 65
W. E. Hawley, Pittsburgh,	105,436 33
Ridge Bros. Company, Pittsburg,	125,441 46
C. J. Carothers, Greensburg,	97,119 18
Filbert Paving and Construction Company, Philadelphia,	124,262 58
John McManamy, Philadelphia,	134,528 33
	139,341 17
J. F. Dietz, Johnstown,	219,000 00
E. T. Beck & Company, Warren,	134,547 23
United Ice and Coal Company, Harrisburg,	101,454 93
S. Pearson & Sons, Incorporated, New York,	130.128 20
H. G. Hinkle, Incorporated, Altoona,	1,115,994 59

National Pike, Fayette and Somerset counties:

	Section 12.	Section 9.	Section 10.
Reed & Patton, Curwensville,	$67,458 00	....	$46,429 28
J. F. Hawley & Company, Pittsburgh,	89,955 00	....	....
James Corcoran Company, Pittsburg,	90,080 10	....	....
C. J. Carothers, Greensburg,	87,987 35	....	....
A. V. Purnell, Pittsburg,	77,545 45	42,303 61	57,922 60
Charles T. Eastburn, Yardley,	75,350 65	41,372 72	55,859 65
Public Service Construction Company, Buffalo, N. Y.,	75,923 53	42,076 85	....
R. D. Malone & Company, Washington, D. C.,	88,785 55	48,506 52	....
V. D. Giomo & Company, Pittsburgh,	94,749 44	54,688 84	....
W. E. Hawley & Company, Pittsburgh,	82,378 95	....	....
James Nixon, Clairton,	....	53,494 30	....
John F. Hawley, Pittsburg,	....	51,725 21	....
Uniontown Construction Company,	....	43,258 65	....
Rietsch Bros.,	....	50,023 90	....
J. C. McSpadden, Pittsburgh,	....	....	60,768 83
Neelen & Daly, Pittsburgh,	....	....	60,384 18

WATER SUPPLY.

Permits

Harrisburg: The Water Supply Commission of Pennsylvania has approved the following applications:

Florin: Florin Water Company, for the supply of water to the public in the township of Mount Joy, Lancaster county.

Warren: Newmaker and Reed, of Warren, for the reconstruction of a dam over Conewago creek, at Warren, Pennsylvania.

Lehigh Gap: Lehigh Valley Railroad Company, for the placing of an embankment and slope along the west bank of the Lehigh river about a half mile south of Lehigh Gap, Pennsylvania.

Harrisburg: Merger and Consolidation of Telford Water Company, Reliance Water Company, Rockhill Water Company and Telford Water Company, forming the Telford Water Company.

Somerset county: Hillside Water Company, for the supply of water to the public in the township of Upper Turkeyfoot, Somerset county.

Clinton county: Commissioners of Clinton county, for the construction of a bridge over the West Branch of the Susquehanna river between the boroughs of Renovo and South Renovo, Pennsylvania.

The following applications were held under advisement:

Addison: Gravity Water Company, for the supply of water to the public in the township of Addison, Somerset county.

Somerset county: Pure Mountain Water Company, for the supply of water to the public in the township of Black, Somerset county.

Towanda: Towanda Water Power Company, et al., for the construction of a dam in the Susquehanna river near Towanda, Pennsylvania.

Clinton county: Commissioners of Clinton county, for the construction of a steel highway bridge over the West Branch of the Susquehanna river at McElhattan, Pennsylvania.

Clarion: A hearing was held on the Clarion river-Tionesta creek water power project, and the same was held under advisement.

Harrisburg: The State Water Supply Commission has approved the application for a charter for the Evitts Creek Water Company, of Cumberland Valley township, Bedford county, which will furnish water to the city of Cumberland, Maryland.

The commission has held three hearings in the matter and prior to granting the application, Col. George A. Pearre, of Cumberland, representing those opposed to abandoning the city's Potomac river supply and spending half a million on a new supply, argued against the proposition. City Attorney D. L. Sloan and Lyman D. Gilbert of this city, represented Cumberland which had a special act passed by the Maryland legislature, providing for a loan to cover the proposed dam in Evitts creek. This reservoir will be two miles from the Mason and Dixon line and within Pennsylvania.

Colonel Pearre claimed that the Potomac is now polluted by mines and manufactories and that the granting of the charter by Pennsylvania would encourage the breaking of the Maryland laws in regard to stream pollution. This charter will be the first ever issued in Pennsylvania for a company that intends to take its water outside the state.

General

Scranton: The Moscow Water Company has increased its indebtedness from nothing to $20,000.

Elizabethville: The capital of the Elizabethville Water Company has been increased from $20,000 to $35,000.

Emporium: The Emporium Water Company has increased its capital from $60,000 to $100,000.

Allentown: The trustees of the State Hospital for the Insane at Rittersville have decided to install a water works system, comprising a pumping station, electrically driven pumps, a force main, large storage reservoir on the nearby hill and a gravity supply by main. Philip Johnson, of the Land Title Building, Philadelphia, is the engineer in charge of the plans.

Greencastle, Franklin county: Mason D. Pratt, of Harrisburg, has been engaged as the engineer to draw plans for a storage reservoir for this place.

New Dickinson Run borough, Fayette county: This borough will build a water works system, the operation being carried on by the Dickinson Run Water Company which will also build a water works plant. This town is partly in Dunbar and partly in Franklin townships, Fayette county.

Bath, Northampton county: Extensions in the way of an improved reservoir and a water works system will be made as soon as possible here.

Unionville, Centre county: Unionville will install a water works system this year.

Conneautville, Crawford county: Extensive enlargements to the water works system will be made, including the construction of reservoirs and a new supply main.

Marion Centre, Indiana county: J. H. Rochester, who owns the Marion Centre Water Company, will extend his system in this town.

Sebring, Ohio: The Sebring, Ohio, Water Company has employed Chester & Fleming of Pittsburgh, Pennsylvania, to prepare plans and specifications for the installation of additional pumping machinery.

Wheeling, West Virginia: The City and Elm Grove Railroad Company has employed the firm of Chester & Fleming, Consulting Engineers of Pittsburgh, to make a complete examination and report of the water works for Pleasant Valley, a suburb of Wheeling, with reference to extensive improvements in the water supply.

MISCELLANEOUS.

Charters

Pittsburgh: Westinghouse Gear and Dynamometer Company; acquiring and dealing in inventions relating to engines and gear; capital, $5,000; treasurer, Alexander Black, 249 Forty-third street, Pittsburgh.

Philadelphia: American Hollow Steel Sash Company, manufacturing from metal or wood window sashes and frames; capital, $10,000; treasurer, Raymond W. Tunnell, 251 West Walnut Lane, Germantown.

Pittsburgh: The G. F. Higgins Company, construction engineers; capital, $20,000; treasurer, John L. Mullen, Union Bank building, Pittsburgh.

Yukon: Yukon-Waltz Telephone Company; capital, $5,000; treasurer, D. H. Heller, Ruffsdale.

Engineers' Society of Pennsylvania

THIRD SERIES. OCTOBER, 1911 No. 10.

MONTHLY BULLETIN

ENGINEERING WORK PROPOSED

In this column is published each month news relating to proposed engineering work in Pennsylvania, as far as such information is obtainable. This service will be useful to contractors and the trade in Builders' Supplies. The items of interest embrace engineering constructive work of all kinds and degrees of magnitude. Send in the notes to Chas. G. Miller, Editorial Staff, on or before the first day of each month.

BUILDINGS.

Charters

Pittsburg: The G. F. Higgins Company, carrying on the business of designing and construction engineers; capital, $20,000; treasurer, John L. Mullen, Union Bank Building, Pittsburg.

Harrisburg: Broome Construction Company, carrying on a general contracting and construction business, including the erection of buildings, bridgs, etc.; capital, $5,000; treasurer, George L. Reed, Harrisburg.

INDUSTRIAL.

Charters

Benton, Columbia county: Benton Roller Mills, manufacturing flour and feed; capital, $20,000; treasurer, John J. Mather, Benton.

East Greenville, Montgomery county: Manufacturing washing machines, chests, kitchen and household goods; capital, $60,000; treasurer, Francis S. Shelley, East Greenville.

Philadelphia: H. Cramer, Incorporated, manufacturing wearing apparel; capital, $30,000; treasurer, Israel Brod, 1835 Erie avenue, Philadelphia.

Philadelphia: Petry Cassidy, Incorporated, manufacturing automobiles; capital, $10,000; treasurer, Edward A. Cassidy, Delmar Apartments, Germantown, Philadelphia.

Great Bend, Susquehanna county: Demer Brothers Company, manufacturing cut glass; capital $25,000; treasurer, Philip J. Demer, Hallstead.

Conshohocken: Conshohocken Ice Company, manufacturing ice; capital, $5,000; treasurer, Julian P. Wright, 112 North Broad Street, Philadelphia.

Philadelphia: G. F. Shuster Company, manufacturing shoes; capital, $25,000; treasurer, William S. Rendell, Mt. Holly, N. J.

Warren: Pickett Hardware Company, manufacturing iron or steel; capital, $100,000; treasurer, Louis Brown, 215 Water street, Pittsburg.

Mt. Pleasant township, Westmoreland county: Pittsburg Gas Stove and Manufacturing Company, manufacturing stoves, ranges and furnaces; capital, $5,000; treasurer, Edward J. Daschbach, 54 Carrick avenue, Carrick.

Spring City, Chester county: Pennsylvania Stove and Range Company, manufacturing stoves, ranges and heaters; capital, $150,000; treasurer, William P. Miles, Spring City.

Philadelphia: American Hollow Steel Sash Company, manufacturing articles of commerce from metal or wood, such as sashes and frames; capital, $10,000; treasurer, Raymond W. Tunnell, 251 West Walnut Lane, Germantown, Philadelphia.

Philadelphia: The J. M. Shock Absorber Company, manufacturing shock absorbers to be used in connection with automobiles and other vehicles; capital, $5,000; treasurer, Camille A. Contal, 6, avenue de Magenta St. Cloud, France.

Philadelphia: Philadelphia Truck Company, manufacturing automobiles and other vehicles; capital, $10,000; treasurer, Roger W. Griswold, Twenty-second and Chestnut streets, Philadelphia.

Emaus, Lehigh county: Excelsior Silk Company, of Emaus, manufacturing silk and other fabrics; capital, $50,000; treasurer, Ernest J. Stansfield, Emaus.

Monaca, Beaver county: Gooch Koehler Specialty Manufacturing Company, manufacturing filing machines and tools; capital, $5,000; treasurer, Paulius E. Koehler, Monaca.

Pittsburg: Sharpe, Schmunk & Lytle, Incorporated, manufacturing cigars and tobacco; capital, $5,000; treasurer, G. Henry Schmunk, 100 East North avenue, N. S., Pittsburg.

DuBois, Clearfield county: Bohemian Art Pottery Company, manufacturing pottery, fire brick, tile and sewer brick; capital, $25,000; treasurer, M. I. McCreight, DuBois.

Johnstown: The Keystone Excavating and Grading Machine Company, manufacturing excavating and grading machinery; capital, $20,000; treasurer, A. E. Fichtner, 217 Fairfield avenue, Johnstown.

Wyomissing, Burks county: Wyomissing Supply Company, manufacturing planing mill work; capital, $40,000; treasurer, Wayne L. Shearer, Reading.

Philadelphia: Pioneer Knitting Mills; capital, $10,000; treasurer, Louis I. Bellow, 5178 Viola street, Philadelphia.

Dillsburg: Dillsburg Clay Products Company; capital, $5,000; treasurer, John W. Wetzel, Carlisle.

Shickshinny, Luzerne county: The Consumers Paper Company, manufacturing carbon, paraffine and other papers; capital, $50,000; treasurer, D. Z. Mensch, Shickshinny.

Philadelphia: Bankerd & Outerson Company, manufacturing paper; capital, $20,000; treasurer, John W. Outerson, Philadelphia.

Pittsburg: Acme Novelty Company, manufacturing toys and novelties; capital, $10,000; treasurer, Ralph E. Gill, 905 Maryland avenue, Pittsburg.

Somerset: Somerset Dairy Co-operation, manufacturing agricultural and dairy products; capital, $10,000; treasurer, Edward W. Cleeves, Somerset.

Pittsburg: Safety Lamp and Metal Manufacturing Company; capital, $20,000; treasurer, Alexander Little, 209 Seventh street, Pittsburg.

Chester: Penn Ice Works, Incorporated, manufacturing ice; capital, $75,000; treasurer, Norman C. Craig, Chester.

Grove City: The Bessemer Motor Truck Company, manufacturing motor vehicles; capital, $100,000; treasurer, I. M. Lewis, Grove City.

Harrisburg: Capsule Drug Company, manufacturing drugs and chemicals; capital, $5,000; treasuerr, H. R. Engle, Harrisburg.

Aliquippa, Beaver county: Aliquippa Ice Company, manufacturing ice; capital, $5,000; treasurer, William Lauler, 41 North Boquet street, Pittsburg.

Philadelphia: H. W. Scattergood Company, manufacturing stationery and blank books; capital, $25,000; treasurer, William A. Brous, Oreland.

Butler: Butler Button Company, manufacturing buttons; capital, $5,000; treasurer, J. F. Anderson, Butler.

Philadelphia: A. Blumenthal, manufacturing cloths of wool; capital, $10,000; treasurer, J. Fred Sheridan, 21 South Hanover street, Baltimore.

Philadelphia: Millards, manufacturing wearing apparel; capital, $10,000; treasurer, Millard H. Herzberg, The Parkside, Philadelphia.

Philadelphia: Elite Millinery Shop, manufacturing wearing apparel; capital, $10,000; treasurer, Ella E. Yeager, Philadelphia.

Philadelphia: Miller Clothing Company, manufacturing wearing apparel; capital, $5,000; treasurer, Louis Lock, 1324 Bainbridge street, Philadelphia.

Bradford, McKean county: Tune Valley Pressed Brick Company, manufacturing brick of shale and clay; capital, $105,000; treasurer, George W. Foster, Lewis Run.

Catasauqua: Catasauqua Silk Company, manufacturing silk fabrics; capital, $15,000; treasurer, Wilson J. Smith, Catasauqua.

Philadelphia: L. A. Proutz Company, manufacturing soda water fountains; capital, $25,000; treasurer, E. F. Kelly, 3815 Hamilton street, Philadelphia.

Philadelphia: New Hope Shale Brick Company; capital, $5,000; treasurer, Jacob D. Landes, 1525 Mt. Vernon street, Philadelphia.

Philadelphia: William B. Lukens Lumber Company, manufacturing lumber; capital, $100,000; treasurer, William B. Lukens, Hotel Clinton, Tenth and Clinton streets, Philadelphia.

Washington township, Northampton county: Ackermanville Milling Company, manufacturing flour; capital, $7,000; treasurer, Charles Schimmel, Ackermanville.

Hyde Park, Berks county: Hyde Park Manufacturing Company, manufacturing machinery, hammers, ball bearings, etc; capital, $45,000; treasurer, J. Wallace Miller, Muhlenberg township, Berks county.

Philadelphia: Quaker Lace Company, manufacturing fabrics; capital, $2,500,000; treasurer, Joseph H. Bromley, Chelten avenue and Wissahickon street, Philadelphia.

Scranton: Eureka Motor Car Company, manufacturing motor vehicles; capital, $25,000; treasurer, O. D. DeWitt, Scranton.

West York Borough: Souter Silk Manufacturing Company; capital, $25,000; treasurer, Herman Z. Shetter, West Market street, York.

Erie: Erie Pump and Engine Works, manufacturing engines and machinery; capital, $50,000; treasurer, Don H. DuMond, Erie.

Pittsburg: Laughlin-Barney Machinery Company; capital, $50,000; treasurer, Henry E. Barney, Pittsburg.

General

Somerset: The Standard Quemahoning Coal Company has increased its indebtedness from $23,999.99 to $47,999.99.

Pittsburg: Bessemer Coke Company has increased its indebtedness from $305,000 to $425,000.

Philadelphia: The Peoples Wagon Company has increaed its capital stock from $10,000 to $40,000.

Erie: Hammerhill Paper Company has decided upon an increase of capital stock from $960,000 to $1,500,000.

Williamsport: The Keystone Glue Company has increased its stock from $50,000 to $500,000.

York: The Fitz Water Wheel Company has increased its capital from $30,000 to $60,000.

Scranton: The Hull Manufacturing Company has increased its capital stock from $10,000 to $20,000.

Pittsburg: The capital of the Aspinwall Automobile Company has been increased from $7,500 to $15,000.

Greensburg: The Vandergrift Telephone Company has increased its indebtedness from $45,000 to $100,000.

Berwick: The Berwick Lumber and Supply Company, has increased its indebtedness from $10,000 to $45,000.

Chester: The American Road Machine Company has authorized an increase of its capital from $765,000 to $768,900.

Bethlehem: The Lehigh Shoe and Rubber Company has increased its capitalization from $20,000 to $30,000.

Riegelsville: The Riegelsville Manufacturing Company has increased its indebtedness from nothing to $12,000.

Franklin: Emmert Manufacturing Company has increased its capital stock from $40,000 to 60,000.

Greensburg: The Lacolle Coal Mining Company has increased its capital from $5,000 to $200,000.

Stroudsburg: The Stroudsburg Engine Works has increased its stock from $60,000 to $90,000.

Pittsburg: The Washington Tin Plate Company has increased its capitalization from $300,000 to $350,000.

Franklin: The capital stock of the Landis Machine Company has been increased from $50,000 to $100,000.

Pittsburg: The Fifth Avenue and Wood Street Corporation has increased its capital from $5,000 to $500,000.

Wilkes-Barre: The Wilmot Engineering Company has increased its capital from $50,000 to $100,000.

Reading: The Keystone Shoe Manufacturing Company has increased its indebtedness from $26,500 to $36,500.

Philadelphia: The Harleigh-Brookwood Coal Company has authorized an increase of its capital from $20,000 to $500,000; its indebtedness has been increased from $155,000 to $1,500,000.

Reading: The Reading Hardware Company has increased its capital from $900,000 to $1,700,000.

Scrantón: The Clear Spring Coal Company has decreased its capital from $320,000 to $32,000.

LIGHT, HEAT AND POWER.

Charters

McDonald, Washington county: Independent Electric Company, of North Fayette township; capital, $5,000; treasurer, Robert A. Scott, Wilkinsburg.

McDonald: Independent Electric Company of Oakdale; capital, $5,000; treasurer, Robert A. Scott, Wilkinsburg.

McDonald: Independent Electric Company, of McDonald; capital, $5,000; treasurer, Robert A. Scott, Wilkinsburg.

McDonald: Independent Electric Company of Collier township, capital $5,000; treasurer, Robert A. Scott, Wilkinsburg.

Snow Shoe township, Centre county: Clarence Electric Company; capital, $5,000; treasurer, John W. Wrigley, Clearfield.

Pike township, Clearfield county: Pike Township Electric Company; capital, $5,000; treasurer, A. W. Bigler, Clearfield.

Sunbury: Northumberland County Gas and Electric Company; capital, $5,000; treasurer, J. Charles Murtagh, West Chester.

Reading: Adamstown Electric Company; capital, $5,000; treasurer, George L. Roller, Reading.

Reading: Brecknock Township Electric Company; capital, $5,000; treasurer, George L. Roller, Reading.

Easton: Bethlehem Power Company, supplying light, heat and power in the township of Bethlehem, Northampton County; capital, $5,000; treasurer, B. S. Lachlan, Plainfield, N. J.

Easton: Borough of Nazareth Power Company; capital, $5,000; treasurer, B. S. Lachlan, Plainfield, N. J.

Easton: Lower Nazareth Power Company; capital, $5,000; treasurer, B. S. Lachlan, Plainfield, N. J.

Easton: Upper Nazareth Power Company; capital, $5,000; treasurer, B. S. Lachlan, Plainfield, N. J.

Lehighton, Carbon county: Public Service Company of Lehighton, supplying gas for light; capital, $5,000; treasurer, Henry S. Morris, 868 Drexel Building, Philadelphia.

Carlisle: Carlisle Light, Heat and Power Company; capital, $5,000; treasurer, L. R. Brenneman, Carlisle.

Pittsburgh: The Wood Street Electric Company; capital, $5,000; treasurer, H. V. Blaxter, 5723 Darlington Road, Pittsburg.

Pittsburg: New Alexandria Electric Company, manufacturing light, heat and power; capital, $5,000; treasurer, George T. Smith, Cain and Dursan streets, Pittsburg.

Pittsburg: Midway Electric Company; capital, $5,000; treasurer, L. B. Custer, Wilkinsburg.

Pittsburg: Saltsburg Electric Company; capital, $5,000; treasurer, A. Elbert DuBois, Wilkinsburg.

Sunbury: Point Township Electric Company; capital, $5,000; treasurer, R. V. West, Sunbury.

Sunbury: West Chillisquaque Township Electric Company; capital, $5,000; treasurer, R. V. West, Sunbury.

General

Harrisburg: Papers announcing two large mergers of illuminating and power companies have just been approved by Governor John K. Tener, and have been placed on file at the State Department. The Edison Electric Company of Lancaster, with a capital of $1,500,000 was formed by the merger of the following companies: Edison Electric Illuminating Company, of Lancaster; Columbia Light, Heat and Power Company, Lititz Electric Light, Heat and Power Company, Mountville, Penn Township, Rappho Township, Mount Joy Township, East and West Donegal Townships, electric companies; East and West Lampeter Townships, East and West Hempfield Townships, Manor Township, Manheim Township, Warwick Township, and Lancaster Township Electric Companies and Manheim Suburban Electric Company. The officers are W. W. Griest, Lancaster, president; George Bullock, vice-president, and J. S. Graybill, Jr., secretary and treasurer.

The Edison Electric Illuminating Company, of Sunbury was formed with $250,000 capital by the merger of the Sunbury Gas, Edison Electric Illuminating, Sunbury Electric Light and Power, Northumberland Electric Illuminating and United Light and Power Companies. The officers are George Scott Stewart, Philadelphia, president; W. W. Hepburn, Philadelphia, vice-president, and E. R. Tatnall, Haverford, secretary and treasurer.

Greensburg: The indebtedness of the Vandergrift Electric Light and Power Company has been increased from $90,000 to $300,000.

Sunbury: The Northumberland County Gas and Electric Company has increased its capital from $5,000 to $1,000,000 common and $350,000 preferred stock. The indebtedness of the company has been increased from nothing to $2,000,000.

MISCELLANEOUS.

Charters

Pittsburgh: Westinghouse Gear and Dynamometer Company, acquiring and dealing in inventions or designs relating to engines, power, gears, transferring of power and recording of power transmitted; capital, $5,000; treasurer, Miles H. England, 249 Forty-third street, Pittsburgh.

Kane, McKean county: Berry Oil and Gas Company, drilling for, producing and selling petroleum oil and natural gas; capital, $25,000; treasurer, W. A. Wray, Tylersburg.

DuBois: Cramer Quarry Company, mining for limestone, fire clay and other minerals; capital $20,000; treasurer, John C. Arnold, DuBois.

Pittston: McCauley Coal Company, mining coal; capital, $25,000; treasurer, William H. McCauley, Wyoming, Pa.

Pittsburgh: Pittsburgh Pipe Line Construction Company, constructing and maintaining pipe lines for the transportation of petroleum, gas and water; capital, $10,000; treasurer, N. A. Sutton, Steubenville, Ohio.

Pittsburgh: Vogel-Fischer Oil and Gas Company, mining petroleum, oil and gas; capital, $5,000; treasurer, Charles B. Fischer, 2916 Carson street, Pittsburgh.

Shaner Station, Westmoreland county: Zunzle Ferry Company, constructing and operating a ferry for the transportation of passengers, live stock and freight over the Youghiogheny river, from Shaner Station to Stringtown.

Mount Union, Huntingdon county: Mount Union Refractories Company, quarrying rock, clay, magnesite and chrome ore, capital, $300,000; treasurer, Francis D. Halstead, Mount Union.

Pittsburgh: Burrell Coal Company, mining coal and manufacturing coke; capital, $5,000; treasurer, John R. Taylor, Freeport.

MacDonaldton: On September 15th, a masonry dam 420 feet long and 20 feet high constructed by the Brothers Valley Coal Company near MacDonaldton, slid on being subjected to full water pressure. Chester & Fleming of Union Bank Building, Pittsburgh, were employed to make examination and report, and have since been commissioned to take charge of the strengthening and repairing of this dam.

On sliding, the water broke under the dam and was so throttled that the reservoir emptied slowly and did but little damage below.

Warrensville, Lycoming county: Blooming Grove Bell Telephone Company, constructing and operating lines in Lycoming County; capital, $5,000; treasurer, D. H. Super, Warrensville.

Prittstown, Fayette county: Fayette Rural Telephone Company, constructing and operating lines in Fayette County; capital, $5,000; treasurer, Albert W. Truxel, Mt. Pleasant.

Heverly, Clearfield county: Vivian Coal and Coke Company, mining coal and other minerals, capital, $5,000; treasurer, T. Frank Bartholomew, 1216 South Fifty-third street, Philadelphia.

Sunbury: Juniata Sand Company, mining for sand and other building materials; capital, $10,000; treasurer, Ambrose Persing, Sunbury.

RAILWAYS.

Charters

Harrisburg: The charter application of the Pennsylvania Northern Railroad has been approved by Governor Tener. This company will build and operate a fifty-mile stretch of line between Clarion and Hallton, extending through Elk, Forest, Jefferson and Clarion counties.

The capital is $500,000 and General Charles Miller, of Franklin, and H. Buckingham, of Clarion, president of the company, own practically all of the stock. The directors are Mr. Buckingham and J. M. Curry, Clarion; D. W. Morgan, J. S. Carmichael, C. C. Steinbrenner, Emery C. Read and George C. Miller, Franklin.

General

Harrisburg: Governor Tener has approved the merger papers of the Sunbury and Northumberland Electric Company with the Northumberland Traction Company, of Sunbury. The merger company has a capital of $50,000 and a bonded debt of $2,000,000. The officers are D. A. Howe, Williamsport, president; George Parker, Philadelphia, secretary.

Bloomsburg: Notice has been sent to the State Department of the reorganization of the Bloomsburg and Millville Railroad Company under the name of the Bloomsburg, Millville and Northern. The new company has a capital stock of $225,000 and D. O. Coughlin of Bloomsburg, is president. The company has made an issue of bonds for $225,000.

Philadelphia: The Northumberland County Traction Company has increased its capital stock from $10,000 to $500,000; its indebtedness from nothing to $2,000,000.

Sunbury: The board of directors of the Chillisquaque Connecting Railway Company have decided to extend the route of the company's line a distance of 12,780 feet.

Pittsburg: Extensive work on new lines for the Duquesne Street Railway Company will be done this fall.

Milton: The Montandon & Milton Railway Company will make extensions of its route.

SEWERAGE.

Charters

East Stroudsburg, Monroe County: The East Stroudsburg Sewerage Company has been chartered with a capital stock of $8,000; it will construct and maintain sewers throughout the borough. Franklin J. Kistler, East Stroudsburg, is the treasurer.

General

Lykens: The borough of Lykens, Dauphin County, will, as soon as plans now before the State Department of Health are acted upon, begin the construction of a modern sewerage system. This borough, at the request of the State, has been working towards a sewer system that will meet the requirements of the health authorities. At present most of the sewers in the town are private ones.

STREETS AND ROADS.

General

Harrisburg: State Highway Commissioner Bigelow has fixed October 26th as the date for the opening of bids for the construction of 6,500 feet of highway in Moreland township, Montgomery county. This will be the third section of State road to be built under the Sproul act, work having been started on the Lewistown and Mifflin contracts last month.

The commissioner has also let a contract for the construction of 5,048 feet of highway in Salladasburg borough, Lycoming county, to the Juniata Paving Company, of Philadelphia, the price being $13,225.40.

Harrisburg: Applications for the construction of 78.85 miles of highway under the provisions of the law permitting the state to pay fifty per cent. of the cost have been filed at the State Highway Department. The counties have joined with the borough and townships desiring the improvements in all instances and Highway Commissioner Bigelow will have the surveys and estimates prepared at once. The plan of the department is to link up these sections of road with the main highway system.

The thirty-six applications, aggregating 416,363 feet, come from the following counties and districts: Berks, Hereford, 7,920 feet; Mercer, Sandy Lake, 5,500 feet; Hickory, 23,760 and 15,000; Cambria, Barr, 17,424; Elk, Benzinger, 10,610, 7,920 and 7,425; St. Mary's borough, 5,280 and 9,100; Fayette, Redstone 12,280; Menallen, 16,800, and Lower Tyrone, 6,000; Erie, Union, 7,920, and Mill Creek, 9,000; Dauphin, Upper Paxton, 13,600; Delaware, Springfield, 5,800; Franklin, Hamilton, 21,120; Clearfield, Osceola, 2,500; Northumberland, Rockfeller, 9,600; Bradford, Tuscarora, 20,772; Franklin, Washington, 26,400; Washington, Cecil, 35,870; Montgomery, Moreland, 3,522, and Limerick, 19,350; Cambria, Portage, 15,000; Chester, East Bradford, 14,430; Tioga, Jackson, 18,840; Butler, Clinton, 18,840; Middlesex, 15,000; and Butler township, 6,000.

WATER SUPPLY.

Charters

Sunbury: Bellevue Spring Water Company, delivering water in receptacles; capital, $5,000; treasurer, George F. Keefer, Sunbury.

Applications

Harrisburg: After a consultation with members of the executive staff of the Pittsburgh Flood Commission the State Water Supply Commission has held over the applications for charters for the Clarion River-Tionesta Creek water power project, which includes the building of two large dams. These applications have been pending since spring and several hearings have been held, objections having been made by residents of Clarion, Forest and Warren counties. The conference was to the extent the projects would interfere with the work of the United States Conservation authorities and the flood commission, which outlined their plans.

Harrisburg: The Commissioners have approved the following applications for Charters for water companies:

Washington County: Citizens Water Company of Cecil Township, Washington County.

Washington County: Citizens Water Company of Mount Pleasant Township, Washington County.

Allegheny County: Citizens Water Company of North Fayette Township, Allegheny County.

Washington County: Citizens Water Company of Robinson Township, Washington County.

Washington County: Citizens Water Company of Smith Township, Washington County.

Allegheny County: Citizens Water Company of South Fayette Township, Allegheny County.

Beaver County: Eastvale Water Company, Eastvale, Beaver County.

Westmoreland County: Smithton Water Company, Smithton, Westmoreland County.

Clinton County: The application of the Commissioners of Clinton County, for the construction of a bridge over the West Branch of the Susquehanna river, ner McElhattan, Clinton County, was approved according to revised plans.

Blackburn: The application of the Linde Air Products Company, for the construction of a bridge over Turtle creek, near Blackburn, was disapproved.

Bethlehem: The application of the Minsi Trail Bridge Company, for the construction of a bridge over the Lehigh river east of Bethlehem, was approved conditionally.

Harrisburg: The following applications for charters for water companies were continued by the commissioners: Wayne Water Company, for North Manheim Township, Schuylkill County; Cressona Water Company, for the borough of Cressona, Schuylkill county.

General

Emaus: The borough of Emaus, Lehigh county, Pennsylvania, has employed the firm of Chester & Fleming, consulting engineers, of Pittsburgh to design and install a disinfecting plant for the water supply of this borough. The plant will be installed at the main pump station and will drain the entire supply which is obtained from drilled wells in limestone formation.

Pittsburgh: Chester & Fleming, hydraulic engineers of Pittsburgh have been employed by the city of Alliance, Ohio, to make an investigation and submit a report with recommendations on proposed improvements and extension of water supply.

Homestead: The borough of Homestead has employed the firm of Chester & Fleming, hydraulic engineers of Pittsburgh, Pa., to make an examination of their water plant and submit a report and recommendations regards its betterment to council.

Greensburg: The indebtedness of the Vandergrift Water Company has been increased from $120,000 to $300,000.

Lehigh County: The Mount Holley Water Company has authorized an increase in its indebtedness from $25,000 to $30,000.

Pittsburg: The Federal Water Company has increased its capitalization from $1,000 to $50,000.

Engineers' Society of Pennsylvania

THIRD SERIES. NOVEMBER, 1911 No. 11.

MONTHLY BULLETIN

GENERAL

The Engineers Club of Baltimore inaugurated the publication of their Monthly Journal, Volume I, Number 2 of which appeared in the early part of the month. The number is devoted entirely and very properly so, to subjects of local interest, the proposed charter and amended by-laws of the Club, the officers and standing committees and editorials explaining the reasons for and purposes of the Club and its Journal.

The composition of the Journal is very pleasing; the page, a trifle smaller than the standard business letterhead, carries two columns of 8 point type, with a broad border. The pages are numbered consecutively with apparently no intention of dividing each issue into separate sections for professional papers, proceedings and editorials. While this makes a very readable single issue, it may be that later developments will require sub-divisions allowing the professional papers to be bound in volumes with consecutively numbered papers. This, however, is a matter which will of course be worked out by the Publication Committee in the manner best suited to the particular requirements of the Club.

The Club and its Editors are to be congratulated upon the step which they have taken. They deserve the hearty co-operation and support of both readers and advertisers.

The Alabama Coal Operators' Association during the last two years has, through its organization and through the individual efforts of its members, given considerable attention to the subject of accident prevention both on the surface and underground. This work has been supplemented by the organization and training of a number of First Aid Corps.

At the annual meeting of the Association last August the subject of Tuberculosis was given special consideration, particularly those features relating to its prevention and cure in its early stages. In extension of this general policy the Association has just engaged the well known Engineer, Mr. Morris Knowles, of Pittsburgh, who is now actively at work in making a social and sanitary survey of the Coal Mining Camps represented in the organization. The work as outlined is rather comprehensive, embracing housing conditions, the more strictly fundamental sanitary features including drinking water supplies, closets, sewage and garbage disposal, etc. The rather difficult problems of education and recreation will also be given proper consideration.

As a result of concerted effort along these lines, it is hoped that living conditions throughout the State will be such as to entitle Alabama to first rank in matters of this character. This is perhaps the first instance noted in which the Operators of any important District have undertaken such a concerted and scientific study of camp life.

ENGINEERING WORK PROPOSED

In this column is published each month news relating to proposed engineering work in Pennsylvania, as far as such information is obtainable. This service will be useful to contractors and the trade in Builders' Supplies. The items of interest embrace engineering constructive work of all kinds and degrees of magnitude. Send in the notes to Chas. G. Miller, Editorial Staff, on or before the first day of each month.

BUILDINGS.

Charters

Pittsburg: H. Miller & Sons Company, contracting for building operations; capital, $25,000; treasurer, Louis H. Miller, 238 Dinnwiddie street, Pittsburgh.

LIGHT, HEAT AND POWER.

Charters

York: Mt. Wolf Electric Light Company, capital, $5,000; treasurer, Charles A. Greenawalt, York.

Kutztown: Kutztown and Tapton Gas Company, manufacturing gas for light only in townships of Hereford, Washington, Swamp, Maxatawney, Richmond, Ruscombe, Rockland, in Bucks county; capital, $5,000; treasurer, C. M. Harlan, 4715 Chester avenue, Philadelphia.

West Pittston, Luzerne county: Garden City Electric Company, supplying light, heat and power; capital, $5,000; Treasurer, J. A. McMillan, 114 Exeter street, West Pittston.

Newport: New Perry County Gas Company, manufacturing gas for light only for Newport borough; capital, $5,000; treasurer, Oscar L. Eppinger, Steelton.

Pittsburg: The Keystone Light Company, supplying light, heat and power by electricity; capital, $100,000; treasurer, Harry C. Fricke, 317 North Craig street, Pittsburg.

Reading: City Light, Heat and Power Company; capital, $5,000; treasurer Thomas J. Connelly, Wilkes-Barre.

Curwensville, Clearfield county: The Anderson Creek Electric Company; capital, $5,000; treasurer, George L. Benner, Curwensville.

Reading: The Edison Electric Company, of Fleetwood; capital, $5,000; treasurer, George L. Roller, Reading.

Reading: The Edison Electric Company, of Kutztown; capital, $5.000; treasurer, George L. Roller, Reading.

Reading: The Edison Electric Company, of Topton; capital, $5.000; treasurer, George L. Roller, Reading.

Reading: Longswamp Township Electric Company, capital, $5,000; treasurer, George L. Roller, Reading.

Reading: Maidencreek Township Electric Company; capital, $5,000; treasurer, George L. Roller, Reading.

Reading: Maxatawney Township Electric Company; capital, $5,000; treasurer, George L. Roller, Reading.

Reading: Richmond Township Electric Company; capital, $5,000; treasurer, George L. Roller, Reading.

Allentown: South Whitehall Electric Light and Power Company; capital, $5,000; treasurer, Charles N. Wagner, Allentown.

Allentown: Salisbury Electric Light and Power Company; capital, $5,000; treasurer, Charles N. Wagner, Allentown.

Allentown: Hanover Electric Light and & Power Company; capital, $5,000; treasurer, Charles N. Wagner, Allentown.

Allentown: Lehigh Valley Light and Power Company; capital, $5,000; treasurer, Charles N. Wagner, Allentown.

Pennsburg: Perkiomen Valley Gas Company, manufacturing gas for light only; capital, $5,000; treasurer, C. M. Harlan, 4715 Chester avenue, Philadelphia.

General

Philadelphia: The Altoona Gas Light and Fuel Company has increased its capital stock from $5,000 to $435,000.

New Bethlehem: Red Bank Electric Company, directors have decided upon an increase of indebtedness from nothing to $10,000.

Knoxville, Pittsburg: The Knoxville Electric Company has decided upon an increase of capital from $100,000 to $200,000.

INDUSTRIAL.

Charters

Pittsburgh: A charter has been issued at the State Department, Harrisburg for the Laughlin-Barney Machinery Company; capital stock, $50,000; treasurer, Henry E. Barney, Pittsburgh.

Union City, Erie county: The Variety Turning and Furniture Manufacturing Company; capital, stock, $15,000; treasurer, P. H. Colt, Union City, Erie county.

Cochrantown: A. B. Gaston Company, manufacturing agricultural implements and novelties; capital, $20,000; treasurer, J. E. Gaston, Cochrantown.

Pittsburgh: R. C. H. Auto Company, manufacturing automobiles and accessories; capital, $5,000; treasurer, K. S. Burley, 5977 Centre avenue, Pittsburgh.

Pittsburgh: The McGinness Company, manufacturing heating and ventilating and sanitary apparatus; capital, $25,000; treasurer, William S. McGinness, Pittsburgh.

Somerset: The Quemahoning Creek Coal Company; mining; capital, $10,000; treasurer, Charles J. Harrison, Jr., Somerset.

Houtzdale, Clearfield county: Quinn and Company, Incorporated, mining for coal, fire clay and other minerals; capital, $25,000; treasurer, John Quinn, Houtzdale.

Verona: Gas and Gasoline Regulator Burner Austria Croatia Company; manufacturing burners and carburetors; capital, $5,000; treasurer, Peter Sviger, Oakmont.

Reading: National Electric Manufacturing Company, manufacturing machinery; capital, $5,000; treasurer, John Gaenzle, Reading.

Easton: Easton Tool and Machine Company, manufacturing iron or steel and tools from either; capital, $25,000; treasurer, Richard J. Lippey, Easton.

Reading: Laurel Hill Valley Coal and Coke Company, mining; capital, $50,000; treasurer, Edwin DeLong, Bowers, Berks county.

Philadelphia: Rubber Standard Paint Company, manufacturing paint and varnish; capital, $20,000; treasurer, E. Russell Foster, 1122 Filmore street, Frankford, Philadelphia.

South Bethlehem: South Bethlehem Knitting Mills, manufacturing spun wool, cotton or silk; capital, $10,000; treasurer, A. C. Graham, South Bethlehem.

Waynesboro, Franklin county: Waynesboro Metal and Foundry Company, manufacturing iron or steel; capital, $50,000; treasurer, George H. Armacast, Westminster Md.

Philadelphia: Tempus Reclaiming and Manufacturing Company, manufacturing machines for compressing into merchantable shapes old wire and light metals; capital, $10,000; treasurer, Frank D. Kane, Ridley Park, Delaware county.

Pittsburgh: Neely-Ardary Oil and Gas Company, prospecting and mining; capital, $20,000; treasurer, G. H. Fugh, 302 North Negley avenue, Pittsburgh.

Johnstown: Citizen's Electric and Gas Appliance Company; capital, $25,000; treasurer, B. F. Cooper, Johnstown.

Philadelphia: Knox Manufacturing Company, manufacturing iron, steel, brass, bronze, copper, lead, zinc, aluminum and other metals; capital, $5,000; treasurer, William S. Feeny, 1222 Airdrie street, Philadelphia.

Philadelphia: Strause Gas Iron Company, manufacturing gas irons and gas fixtures; capital, $100,000; treasurer, Louis J. Strause, 810 North Broad street, Philadelphia.

New Kensington, Westmoreland county: Jacobus Baking Company, manufacturing confectionery, crackers, etc; capital, $5,000; treasurer, Bertha M. Fulton, New Kingston.

Elkland: Highland Milk Condensing Company; capital, $350,000; treasurer, R. L. Latzer, Elkland.

Philadelphia: The American Wood Fireproofing Company; capital, $5,000; treasurer, Arthur D. Smith, 3907 Powelton avenue, Philadelphia.

West Middlesex, Mercer county: Fire Proof Interiors Company; capital, $10,000; treasurer, F. S. Fish, West Middlesex.

Huntingdon: American Silica Sand Company, mining sand, gravel and peppers; capital, $5,000; treasurer, Howard C. Meyer, Pittsburgh.

Philadelphia: Bedford-Pittman Manufacturing Company, manufacturing shears; capital, $10,000; treasurer, R. H. Pittman, Germantown.

Grove City, Mercer county: The Gealy Wrench and Manufacturing Company, manufacturing all kinds of machinery; capital, $50,000; treasurer, Ira C. Black, Grove City.

Wilkes-Barre: The Hershberger Removable Calk Horseshoe Company, manufacturing removable calk horseshoes; capital, $25,000; treasurer, A. S. Hershberger, Dorrancetown.

Lebanon: Hunsicker Engineering Company, manufacturing of iron or steel, of boiler plate, forgings, sugar machinery, etc.; capital, $50,000; treasurer, John Hunsicker, Lebanon.

Allentown: Lehigh Valley Stone and Construction Company, mining stone and engaging in engineering and construction work; capital, $5,000; treasurer, Charles N. Wagner, Allentown.

Philadelphia: Osceola Coal Company, mining coal and manufacturing coke; capital, $10,000; treasurer, William H. Clark, 4216 Walnut street, Philadelphia.

Philadelphia: Pullman Automobile Company, manufacturing power driven vehicles; capital, $25,000; treasurer, Orland M. Parks, 5347 Wynnefield avenue, Philadelphia.

Philadelphia: Thomas P. Skelly Bolt Company, manufacturing bolts, nuts, screws, rivets and cognate articles; capital, $15,000; treasurer, James Finnesey, 849 North Twenty-fourth street, Philadelphia.

Monongahela City, Washington county: Diamond Machine Company, mining machinery, pumps and mechanical appliances; capital, $50,000; treasurer, W R. Murphy, Bellevue.

Pittsburgh: Verona Steel Castings Company, manufacturing castings and forgings of steel and iron; capital, $10,000; treasurer, William Bierman, 4747 Friendship avenue, Pittsburgh.

General

Kutztown: Keystone Shoe Manufacturing Company has increased its indebtedness from $26,500 to $36,500.

Pittsburgh: The June Oil and Gas Company has increased its capital stock from $5,000 to $10,000.

Du Bois: The Cramer Quarry Company has increased its indebtedness from nothing to $20,000.

Boliver: The Boliver Face Brick Company has increased its capital from $50,000 to $250,000; its indebtedness from nothing to $130,000.

Hazleton: The Wilmot Engineering Company has increased its capital from $50,000 to $100,000.

Mercer: The Mercer Broom Company has increased its capital from $15,000 to $40,000.

Auburn: The Auburn Shale Brick Company has increased its capital stock from $100,000 to $150,000.

Saltillo: The Saltillo Telephone Company has increased its capital from $2,500 to $25,000

Pittsburgh: The Pittsburgh Emery Wheel Company directors have voted in favor of increasing the company's capital from $75,000 to $100,000.

Halifax, Dauphin county: The Enterline-Halifax Telephone and Telegraph Company has increased its indebtedness from nothing to $10,000.

Philadelphia: The Harleigh-Brookwood Coal Company has increased its capital from $20,000 to $500,000; its indebtedness from $155,000 to $1,500,000.

Scranton: Clear Spring Coal Company has decreased its capital from $320,000 to $32,000.

Reading: The Reading Hardware Company has increased its capital from $900,000 to $1,700,000.

Windber: The Windber Telephone Company has authorized an increase of capital from $25,000 to $50,000.

Chester: American Bronze Company has increased its capital from $40,000 to $100,000.

Greensburg: The Lacolle Coal Mining Company has authorized an inrease in its indebtedness from nothing to $200,000.

Scranton: The Peoples Coal Company has, at a recent meeting, increased its indebtedness from nothing to $400,000.

Harrisburg: The Harrisburg Iron and Steel Company has increased its indebtedness from nothing to $17,200.

Wilkes-Barre: The Miner-Hillard Milling Company has increased its capital from $500,000 to $750,000.

Beaver: The Martsolf Furniture Company has authorized a reduction of capital from $200,000 to $100,000.

Pittsburgh: The Pittsburgh Gas Stove Company has increased its capital from $5,000 to $100,000.

Dillsburg: The Dillsburg Clay Products Company has increased its capital stock from $5,000 to $50,000.

Pittsburgh: The Pittsburgh Plate Glass Company has increased its capital from $17,500,000 to $22,750,000.

Philadelphia: The J. M. Shock Absorber Company has increased its indebtedness from nothing to $20,000.

Philadelphia: The Primos Chemical Company has increased its capital from $250,000 to $500,000.

Erie: The United States Chair Company has increased its indebtedness from nothing to $30,000

Pittsburgh: The Cummings Structural Concrete Company has increased its capital from $5,000 to $50,000.

Waynesboro: The Landis Machine Company has increased its capital from $100,000 to $500,000.

Du Bois: The Osborne Machine Company has increased its indebtedness from $10,500 to $35,000.

Philadelphia: The Scott Paper Company has increased its capital stock from $300,000 to $500,000.

Clearfield: The Paterson Clay Products Company has decided upon an increase in capital stock from $50,000 to $100,000.

Allentown: The Pottsville Brewing Company has increased its capital from $5000 to $400,000.

Pittsburgh: The Biler Water Heater Company has increased its capital from $100,000 to $250,000.

Allentown: The Lehigh Mills Corporation has increased its capital from $5,000 to $100,000.

Bradford: The Bradford Fireproofing Company has increased its capital from $50,000 to $75,000; its indebtedness from nothing to $25,000.

Scranton: The Pocono Distilling Company has increased its indebtedness from nothing to $50,000.

RAILWAYS.

General

New Castle: The Beaver and New Castle Street Railway Company will make an extension of its lines for a distance of 2.4 miles within the city of New Castle.

Beaver: The Beaver Northern Street Railway Company will extend its lines in the boroughs of College Hill and Beaver Falls.

Pittsburgh: The Westside Electric Street Railway Company will make extensions to its routes:

Bloomsburg: The Bloomsburg, Millville and Northern Railway Company has increased its indebtedness from nothing to $200,000.

SEWERAGE.

Awards

Harrisburg: The contract for additions to the sewage disposal plant of the State Sanatorium for Tuberculosis near Mont Alto, Franklin county, has been awarded by Dr. Samuel G. Dixon, Commissioner of Health, to the Ley Construction Company, Pittsburgh, at a price of $7,844.02. Other bids received were as follows:

Kingdom Construction Company, Baltimore, Md., ...	$8,818.70
Frank L. Gardner, Fayetteville, Pa., ...	10,931.50
Harrison & Schreiber, Philadelphia, Pa., ...	12,372.20

Specifications require that work shall be begun immediately and completed within seventy working days.

Charter

Philadelphia: The Sewage Disposal and Water Systems Company, installing septic sewage disposal and water systems; capital, $10,000; treasurer, H. Evan Taylor, 2205 Pine street, Philadelphia.

STREETS AND ROADS.

Proposal

Harrisburg: Bids for the construction of a road in Montgomery county, Moreland township, were opened by State Highway Commissioner Bigelow. Nine contractors submitted bids. They were as follows:

Filbert Paving & Construction Co., Philadelphia, $21,254.99, for two and one-half inch bituminous-macadam and $22,415.49 for three inch bituminous-macadam; Thomas Meehan & Sons, Mt. Airy, Philadelphia, $29,495.62 and $26,697.22 for Hassan oncrete; Ambler-Davis Company, Philadelphia, $27,202.05; Bornemann-Beitler Construction Company, Philadelphia, $27,663.12; The J. F. Shanley Company, Philadelphia, $29,292.95; Monroe Paving Company, $24,762.21; Neff and Horn, Slatington, $27,426.89; William C. Evans, Ambler, $26,090.26; Charles T. Eastburn, Yardley, $26,615.05.

General

Harrisburg: During the winter work at the State Highway Department will be advanced so that all arrangements are complete by spring for the building of 300 miles of state highways, under the Sproul law. Contracts for these roads will be awarded during the winter months and the forty engineering corps that are now making surveys will continue in their work until the snows make outside work out of the question.

Harrisburg: Requests for state aid in the construction of highways under the new Sproul law have been received at the State Highway Department from Beaver county which desires to help in building 50,000 feet. Delaware county desires aid in constructing 33,000 feet.

WATER SUPPLY.

Award

Bellevue: The Ohio Valley Water Company has awarded the contract for equipping a new high service pumping station to the Harris Pump and Supply Company, of Pittsburgh. Chester & Fleming are Consulting Engineers on this work.

Proposals

Erie: The city of Erie will receive sealed proposals for a triple expansion crank and fly wheel pumping engine of 20,000,000 gallons capacity, in accordance with specifications of Chester & Fleming, Hydraulic Engineers, Pittsburgh.

Permits

Harrisburg: The Water Supply Commission of Pennsylvania has approved the following applications:

Lehman Water Company, supplying water to the public in the township of Lehman, Pike county.

Wayne Water Company, supplying water to the public in the township of North Manheim, Schuylkill county.

Cressona Water Company, supplying water to the public in the Borough of Cressona, Schuylkill county.

New Jersey Zinc Company, of Pennsylvania, for permission to construct an intake pier and conduits in the Lehigh river, in Lower Towamensing township, Carbon county.

County Commissioners of Venango county, for permission to construct a bridge over the Allegheny river at Oil City.

Lehigh Valley Railroad Company, for permission to construct certain embankments at various points along the Lehigh river between Treichler's Station, Lehigh county, and Lizard Creek Junction, Carbon county.

The following applications were disapproved:

Tobyhanna Water Company, supplying water to the public in the village of Tobyhanna, Monroe county.

Shannopin Heights Water Company, supplying water to the public in Hopewell township, Beaver county.

Pennsylvania Railroad Company, for permission to construct five piers in the Schuylkill river, to replace a wooden bridge with deck plate girders, at Royersford.

The following applications were held under advisement:

Weaverstown Water Company, for the supply of water to the public in the township of North Lebanon, Lebanon county.

Marion Center Water Company, for the supply of water to the public in the borough of Marion Center, Indiana county.

Gilberton-Schuylkill Water Company and Girardville Water Company, for an extension of the time in which to commence construction of their works.

Gilberton-Schuylkill Water Company and Girardville Water Company for the annulment of the charter of the Oak Grove Water Company.

Pennsylvania Water and Power Company, for permission to erect weir boards on its dam across the Susquehanna river at McCalls, Ferry, Pennsylvania.

General

Brownsville, Fayette county: The Brownsville Water Company has increased its indebtedness from $62,000 to $90,000.

Harrisburg: The Riverton Consolidated Water Company has increased its capital stock from $100,000 to $200,000.

Williamsport: The Susquehanna Boom Company of this place, which has a large dam in the West Branch and operates under a charter granted in the '40's has been cited to show cause before Attorney General Bell why quo warranto proceedings should not be instituted against it.

The Citizens' Water Company, of Williamsport and the Citizens' Electric Company, of this place, have filed charges that the boom company is not operating the dam for the purposes for which it was chartered, but as a means only for collecting sand.

Shickshinny: The Shickshinny Water Company, which was accused of not having lived up to its charter obligations by W. R. Rustay, of this place, was required to show cause why quo warranto proceedings should not be instituted against it. Acting upon the answer of the company, Deputy Attorney General J. E. B. Cunningham has awarded a writ of quo warranto against the company, to be pressed in case the company fails by January 1, to submit plans for extending its supply to the north and south of the hills of Shickshinny and has work started on these extensions by May 1.

Engineers' Society of Pennsylvania

THIRD SERIES. DECEMBER, 1911 No. 12.

MONTHLY BULLETIN

ENGINEERING WORK PROPOSED

In this column is published each month personal news of interest to members of the Society. Items should be sent to Chas. G. Miller, Editorial Staff, on or before the first day of each month. A member need not hesitate to give news about himself. Such co-operation is essential to the success of the Bulletin.

BUILDINGS.

Proposals

Harrisburg; The State Armory Board has opened bids for the new armory at Bradford, but all have been found to be too high, exceeding the amount appropriated for the purpose. It has been determined that Adjutant General Thomas J. Stewart readvertise for bids. The plans will be altered so that they will come within the appropriation.

General

Cresson; The tuberculosis sanitorium for the treatment of tuberculsis, now being erected here by the State, under the direction of the State Department of Health, will be completed by next Summer and will then be ready to house 320 patients. The main building will have accommodations for 160 persons and the cottages for 160 more. The buildings have been so arranged by State Health Commissioner Dixon that none of them will cast shade upon any other.

INDUSTRIAL.

Charters

Huntingdon; American Silica Sand Company, mining sand, gravel and pebbles; capital, $5,000; treasurer, Howard C. Meyer, Pittsburgh.

Philadelphia; Bedford-Pittman Manufacturing Company, manufacturing shoes; capital, $10,000; treasurer, R. H. Pittman, 247 West Dubal street, Germantown, Philadelphia.

Grove City; The Gealy Wrench and Manufacturing Company, manufacturing wrenches and all kinds of machinery; capital, $50,000; treasurer, Ira C. Black, Grove City.

Wilkes-Barre; The Hershberger Removable Calk Horseshoe Company; manufacturing horseshoes; capital, $25,000; treasurer, A. S. Hershberger, 638 Wyoming avenue, Dorrancetown.

Lebanon; Hunsicker Engineering Company, manufacturing iron or steel; capital, $50,000; treasurer, John Hunsicker, Sr., Lebanon.

Pittsburgh; Lehigh Racing Railway Company, manufacturing roller coasters and amusement devices; capital, $5,000; treasurer, Albert K. Little, Pittsburgh.

Allentown; Lehigh Valley Stone and Construction Company, mining and quarrying stone and engaging in engineering and construction work; capital, $5,000; treasurer, Charles N. Wagner, Allentown.

Philadelphia; Osceola Coal Company; mining coal; capital, $10,000; treasurer, William H. Clark, 4216 Walnut street, Philadelphia.

Philadelphia; Pullman Automobile Company, manufacturing automobiles; capital, $25,000; treasurer, Orland M. Parke, 5347 Wynnefield avenue, Philadelphia.

Philadelphia; Thomas B. Shelly Bolt Company, manufacturing bolts, nuts, screws, rivets, etc.; capital, $15,000; treasurer, James Finnesey, 849 North Twenty-fourth street, Philadelphia.

Athens; The Cary Chemical Company, manufacturing chemicals; capital, $5,000; treasurer, M. A. Sleeper, Athens.

New Castle; Pennsylvania Sand Company, mining and quarrying sand and gravel; capital, $10,000; treasurer, L. M. Uber, New Castle.

East Bangor, Northampton County; Analomink Ice Company, manufacturing ice; capital, $16,000; treasurer, William P. Bray, East Bangor.

Salisbury, Somerset County; Bognton Coal Company, mining bituminous coal; capital, $5,000; treasurer, H. H. Maust, Elk Lick.

Pittsburgh; Deisenroth Steel Company: manufacturing iron and steel; capital, $10,000; treasurer, J. N. Robinsteen, Hay and Rebeccah streets, Wilkinsburg.

Philadelphia; Criterion Decorative Company, Incorporated, manufacturing curtains; capital, $10,000; treasurer, Harry J. Moser, 5924 North Camac street, Philadelphia.

Reading; Epp Granite Company, manufacturing memorials and stone work; capital, $8,000; treasurer, Agnes E. Epp, Reading.

Scranton; Keystone Silk Company, manufacturing silk fabrics; capital, $25,000; treasurer, W. A. Lush, 414 Depot street, Scranton.

Galeton, Potter County; Smith Grab and Tool Company, manufacturing logging grabs and lumbering tools; capital; W. D. Allen, Galeton.

Pittsburgh; Oak Hill Oil and Gas Company, mining and drilling for oil and gas; capital, $28,000; treasurer, A. P. Meyer, Pittsburgh.

Butler; The Butler County Auto Company, manufacturing automobiles; capital, $10,000; treasurer, John Younkins, Butler.

Pittsburgh; Pennsylvania Tank Car Company, manufacturing tank cars; capital, $50,000; treasurer, John P. Hunter, Wellesley avenue, Pittsburgh.

Pittsburgh; J. G. Gareis Company, manufacturing automobile supplies; capital, $25,000; treasurer, John G. Gareis, 1667 Metropolitan avenue, Pittsburgh.

Philadelphia; Fidelity Machine and Manufacturing Company, manufacturing iron and steel and textile machinery; capital, $25,000; treasurer, John J. Higginbottom, 2021 East Huntingdon street, Philadelphia.

Brockwayville, Jefferson county; McKnight Coal Company, mining; capital, $25,000; treasurer, V. F. Taylor, Brockwayville.

Pittsburgh; Pyrene Sales Company, manufacturing fire extinguishers; capital, $25,000; treasurer, H. P. Carr, 1406 Commonwealth building, Pittsburgh.

Franklin; Fulcrum Oil Company, manufacturing lubricating oils; capital, $12,000; treasurer, C. A. Miller, Franklin.

Uniontown, Fayette county; Tri-State Telegraph and Telephone Company, constructing, and operating a telephonic system partly in Pennsylvania, Maryland and West Virginia; capital, $5,000; treasurer, Daniel Sturgeon, Uniontown.

Pittsburgh; American Hamping Company, manufacturing cans, tanks and barrels of metal or wood; capital, $5,000; treasurer, A. M. Lowe, 228 Oakland avenue, Pittsburgh.

Philadelphia; Fibetan Products Company, manufacturing a vegetable tanned fibric; capital, $125,000; treasurer, C. H. Bosworth, 1605 Columbia avenue, Philadelphia.

Pittsburgh; Jenkins Arcade Pharmacy, manufacturing chemicals; capital, $10,000; treasurer, M. T. Kearney, 1409 Park building, Pittsburgh.

Philadelphia; John Grass Wood Turning Company, manufacturing wooden ware; capital, $7,500; treasurer, Frederick Schieler, 2012 North Fourteenth street, Philadelphia.

Allentown; Convertible Ratchet Wrench Company, manufacturing ratchet wrenches from steel and iron; capital, $15,000; treasurer, Harvey J. Wiland, Fourth and Linden streets, Allentown.

Pittsburgh; Bismark Oil and Gas Company, boring, drilling and mining for gas and oil; capital, $10,000; treasurer, John Heinl, Etna.

Lower Mann Station, Mifflin county; James H. Mann Company, manufacturing edged tools; capital, $100,000; treasurer, Walter Mann, Reedsville.

Frackville; Pennsylvania Saw Company, manufacturing saws, tools and hardware; capital, $125,000; treasurer, Albert O. Freas, 301 West Drinker street, Dunmore.

Charleroi; R. & B. Lamp Company, manufacturing lamps; capital, $5,000; treasurer, George F. Rylands, Charleroi.

Philadelphia; Hydro Manufacturing Company, manufacturing hydraulic and mechanical specialties; capital, $25,000; treasurer, Maurice G. Belknap, Thirteenth and Chestnut streets, Philadelphia.

Lancaster; Purity Chemical Company, manufacturing chemicals; capital, $5,000; treasurer, Enos H. Hess, Manheim township, Lancaster county.

Philadelphia; The Lincord Rug Company, manufacturing carpets and rugs; capital, $20,000; treasurer, Harold S. Penny, Jenkintown.

Philadelphia; The Brown-Bucher Company, manufacturing tobacco; capital, $10,000; treasurer, Abbott G. Bucher, Philadelphia.

Philadelphia; C. V. Stahl Motor Company, manufacturing motors and motor vehicles; treasurer, John Scanlin, 43 North Virginia avenue, Atlantic City.

Philadelphia; Enterprise Mill Soap Works, Incorporated, manufacturing soaps; capital, $50,000; treasurer, Joseph W. Liberman, 2411 North Broad street, Philadelphia.

Philadelphia; Richards Garage Company, manufacturing automobiles and gasoline engines; capital, $5,000; treasurer, Carol V. R. Caldwell, 3406 Spring Garden street, Philadelphia.

Northampton; Siegfried Motor Car Company, manufacturing automobiles; capital, $10,000; treasurer, John Warta, Siegfried.

Lancaster; E. B. Andes and Company, manufacturing machinery; capital, $10,000; treasurer, William S. Gleim, Lancaster township, Lancaster county.

Lancaster; Lancaster Insecticide Company, manufacturing chemicals; capital, $10,000; Frank A. Long, 604 East Chestnut street, Lancaster.

Scranton; The Scranton Mills; manufacturing suit goods; capital $100,000; treasurer, Luther Keller, Scranton.

General

Philadelphia; The Kaufmann Manufacturing Company, has increased its capital from $10,000 to $50,000.

Williamsport; The Sweet Steel Company has authorized an increase of indebtedness from $175,000 to $275,000.

Pittsburgh; The Entress Brick Company has increased its capital from $35,000 to $100,000.

Allentown; The directors of the Griesemer Stationary Company has increased its capital from $15,000 to $40,000.

Newtown; The Newtown Producing Company has increased its indebtedness from nothing to $50,000.

Ono; The Ono and Lebanon Rural Telephone Company has increased its capital from $5,000 to $20,000.

Wyomissing; The Narrow Fabric Company has decided upon an increase in its capital stock from $100,000 to $250,000.

Pittsburgh; The Excess Indicator Company has increased its capital from $50,000 to $100,000.

Reading; The Harwood and Von Hohl Piano and Player Piano Company has decided to decrease its capital stock from $50,000 to $5,000.

McDonald; The McDonald Milling Company has increased its capital from $25,000 to $40,000.

Philadelphia; The American Hollow Steel Sash Company has voted to increase its capital from $10,000 to $200,000.

New Castle; The Universal Sanitary Manufacturing Company has increased its indebtedness from nothing to $100,000.

Emaus; The indebtedness of the Emaus Foundry and Machine Company has been increased from $5,000 to $20,000.

Oil City; Ridge View Sand Company has increased its capital from $25,000 to $50,000.

Delta; The directors of the Delta Telephone Company have increased their indebtedness from nothing to $50,000.

Hazelton; The Standard Vending Machine Company has increased its capital stock from $5,000 to $100,000.

Pittsburgh; The Belden Engineering Company has increased its capital stock from $25,000 to $50,000.

Scranton;. The Nay Aug Lumber Company has decreased its capital from $200,000 to $100,000.

Altoona; The Henrietta Coal Mining Company has increased its capital stock from $150,000 to $250,000.

Lebanon; The Lebanon Valley Iron and Steel Company has increased its capital stock from $1,500,000 to $2,000,000.

Waynesboro; The Landis Machine Company has increased its capital stock from $100,000 to $500,000.

Johnstown; The Union Radiator Company has increased its capital stock from $75,000 to $100,000.

Harrisburg; The Paxtang Electric Company has filed a record of its increase of capital from $1,000 to $500,000; its indebtedness from nothing to $750,000.

Philadelphia; Asbestos Manufacturing Company has filed an increase of its capital stock from $100,000 to $250,000.

Chester; The Delaware River Steel Company has increased its capital from nothing to $250,000.

Philadelphia; The Scott Paper Company has increased its capital from $300,000 to $500,000.

South Bethlehem; The Winona Silk Company has increased its bonded indebtedness from nothing to $5,000.

Wilkes-Barre; The Commonwealth Telephone Company has increased its capital stock from $200,000 to $500,000.

Pittsburgh; The Pittsburgh Engraving and Electrotype Company has filed a decree of dissolution.

Clearfield; The Clearfield Bituminous Coal Corporation has increased its indebtedness from $1,000,000 to $6,000,000.

Bellefonte; The Howard Iron and Coal Company has changed its principal office from this place to Howard.

Harrisburg; Governor Tener has approved the articles of merger of the Richard Heckshers Sons Company, capital, $2,000,000, and the Alan Wood. Iron and Steel Company, capital, $7,000,000, under the name of the latter company, with a capital stock of $9,000,000. The companies were located at Philadelphia and the merged company will continue to operate there; Richard G. Wood is the president of the company.

RAILWAYS.

Charter

Harrisburg; Secretary of the Commonwealth McAfee has issued a charter to the Elkwood City and Koppel Street Railway Company for 999 years. The company will operate in Elkwood, Lawrence county and has a capital of $6,000.

General

Northumberland; The Northumberland County Traction Company will make extensions to its routes.

Bloomsburg; An increase of indebtedness from nothing to $220,000 has been authorized by the Bloomsburg, Millville and Northern Railway Company.

Philadelphia; The Philadelphia and Baltimore Central Railroad Company has made a return of indebtedness in the amount of $10,000,000.

Harrisburg; The Schuylkill and Dauphin Traction Company has increased its capital from $25,000 to $200,000.

SEWERAGE.

General

Harrisburg; Contractors W. H. Opperman and Company, who are building the intercepting sewer here along the Susquehanna river, will complete the work early in the Spring. Meanwhile the work now completed is being protected from the water by riprapping and the Board of Public Works, which has the work in charge, will probably soon advertise for the construction of a stone or concrete retaining wall.

WATER SUPPLY.

Permits

Harrisburg; The Water Supply Commission of Pennsylvania has approved the following applications:

Marion Center Water Company, for the supply of water to the public in Marion Center Borough, Indiana county.

Londonderry Water Company, for the supply of water to the public in Palmyra, Lebanon county.

Board of Public Works of the City of Harrisburg, for permission to construct a dam in the Susquehanna river at Harrisburg.

The application of the Manheim Township Water Company, for the supply of water in Manheim Township, Lancaster county, was disapproved.

The application of the Red Bank Mills, for permission to construct a crib or wharf in Red Bank creek, at New Bethlehem, Clarion county, was approved.

The following applications were held under advisement:

Lawrence Hydro-Electric Company, for the storage, transportation and furnishing of water for manufacturing and other purposes in the Township of Wayne, Lawrence county.

Connoqnessing Power Company, for the supply, storage or transportation of water and water power for commercial and manufacturing purposes in the Township of Wayne, Lawrence county.

The Engineer of the Commission presented his reports upon investigations of the following dams:

Raystown Water Power Company, at Hawns Bridge, Huntingdon county.

Lake Lodore Dam, at Honesdale.

Mt. Penn Suburban Water Company, at Mt. Penn.

Lehighton Water Supply Company, on Long run, near Lehighton, Pennsylvania.

General

Philadelphia; The Honey Brook Water Company has increased its capital stock from $10,000 to $50,000.

Woodlawn; The Hopewell Township Water Company has increased its indebtedness from nothing to $50,000.

Hanover; The Hanover and McSherrystown Water Company has increased its indebtedness from $325,000 to $550,000.

Mt. Pocono; The Fairview Water Company has increased its indebtedness from $11,500 to $22,000.

Elizabethville; The Elizabethville Water Company has increased its capital from $20,000 to $29,750.

Harrisburg; The Board of Public Works will advertise for bids for the construction of a dam to connect the lower end of the city and the Cumberland county shore. Before the construction work can be started Councils must approve the contract. The money was provided by a loan of 1902, the sum being $65,000. Comparatively little of this amount has been expended on surveys and plans. The purpose of the dam is to back the water over the shallow places in the river and the grass flats in summertime and during mosquito breeding periods. The dam will be four and one-half feet in height and will be made of concrete.

Erie; The city of Erie has authorized Chester and Fleming, Hydraulic Engineers, Pittsburgh, Pennsylvania, to prepare plans and specifications for a Steel Stand Pipe, 30 feet in diameter and 90 feet high, to supply the high service district of Erie.

Pittsburgh; The contract for new pumping machinery for the Sebring Water Company has been awarded to the Harris Pump and Supply Company of Pittsburgh. Chester and Fleming, Pittsburgh are consulting engineers for the work.

Philadelphia; The Jackson Water Company has changed its principal office from this city to Vintondale, Cambria county.

LIGHT, HEAT AND POWER.

Charters

Curwensville, Clearfield county; Anderson Creek Electric Company, capital, $5,000; treasurer, George L. Benner, Curwensville.

Reading; Edison Electric Company of Fleetwood, capital, $5,000; treasurer, George L. Roller, Reading.

Reading; Edison Electric Company of Kutztown, capital, $5,000; treasurer, George L. Roller, Reading.

Reading; Edison Electric Company of Topton; capital, $5,000; treasurer, George L. Roller, Reading.

Reading; Longswamp Township Electric Company, capital, $5,000; treasurer, George L. Roller, Reading.

Reading; Maiden Creek Township Electric Company; capital, $5,000; treasurer, George L. Roller, Reading.

Reading; Maxatawney Township Electric Company; capital, $5,000; treasurer, George L. Roller, Reading.

Reading; Richmond Township Electric Company; capital, $5,000; treasurer, George L. Roller, Reading.

Allentown; South Whitehall Electric Light and Power Company; capital, $5,000; treasurer, Charles M. Wagner, Allentown.

Allentown; Salisbury Electric Light and Power Company; capital, $5,000; treasurer, Charles M. Wagner, Allentown.

Harrisburg; Gas Company of Dauphin; supplying light for Lykens and Williamstown; capital, $5,000; treasurer, John C. Wensell, Paxtang.

Exeter; Electric Company of Exeter; capital, $5,000; treasurer, J. A. McMillan, West Pittston.

Exeter; Lackawannock Electric Company; capital, $5,000; treasurer, J. A. McMillan, West Pittston.

Greenville, Mercer county; Mercer County Light, Heat and Power Company; capital, $5,000; treasurer, L. G. Lanning, Greenville.

Pittsburgh; A charter has been issued at the State Department at Harrisburg for the Suterville Electric Company with a capital of $5,000. R. L. Kester, Jr., of 125 Gordon street, Edgewood, is the treasurer.

General

Kane; The Kane Gas Light and Heating Company has increased its capital from $10,000 to $80,000.

Kane; The Citizens' Gas Company has increased its capital from $5,000 to $15,000.

East Brady; The East Brady Gas Fuel Company has increased its capital from $30,000 to $60,000.

St. Mary's; The St. Mary's Gas Company has increased its capital from $150,000 to $250,000.

Pottstown; The Pottstown Water and Gas Company has increased its capital from $225,000 to $400,000.

Pittsburgh; The Centreville Electric Company has sold its franchise to the West Penn Electric Company which has bought out the Derry Township Electric Company, the Forward Electric Company, the Lincoln Electric Company, the Lower Tyrone Electric Company, the Madison Borough Electric Company, the Mahan Electric Company, the Menallen Electric Company, the Mt. Pleasant Township Electric Company, the North Irwin Electric Company, the Penn Borough Electric Company, the Union Township Electric Company, the Upper Tyrone Electric Company.

Reading; The following light, heat and power companies have sold their franchises to the Metropolital Electric Company: Edison Electric Company of Fleetwood, Edison Electric Company of Kutztown, Edison Electric Company of Topton, Longswamp Township Electric Company, Maidencreek Township Electric Company, Maxatawney Township Electric Company, Richmond Township Electric Company.

Benscreek; The Benscreek Light, Heat and Power Company has sold its franchise to the Citizens' Light, Heat and Power Company of Pennsylvania, which has bought the franchises of the Cambria Light, Heat and Power Company, the Stoney Creek Light, Heat and Power Company, the Upper Yodu Light, Heat and Power Company.

Wellsboro; The Covington Glass Company has issued a decree of dissolution.

Lewisburg; The Citizens Electric Company of Lewisburg has increased it capital from $15,000 to $40,000.

Pittsburgh; The First Pool Monongahela Gas Company has filed a decree of dissolution.

Carbondale;. The Carbondale Knitting Company has increased its capital stock from $25,000 to $50,000.

STREETS AND ROADS.

General

Harrisburg; Surveys of sixty-five of the routes for Main Highways carried by the Sproul Main Highway law of 1911 have been completed by the engineering corps of the State Highway Department, according to a report just made by Chief Engineer Samuel D. Foster to Highway Commissioner E. M. Bigelow. In these routes are 2,755 miles, all of which have been surveyed and of this length 621 miles have been plotted.

This work will enable the department to start construction work in the Spring, in some instances, and as soon as the people vote favorably for the $50,000,000 road bond issue the department will have matters in such shape that the construction of the highways can go ahead without a hitch.

The routes surveyed contain many of those upon which bids will be received this winter or during the early Spring. Among the first roads to be constructed will be that from this city to

Gettysburg. Included among the routes completed by the engineers are the following:

Sunbury to Danville; Bloomsburg to Wilkes-Barre; Scranton to Montrose; Bloomsburg to Laporte; Sunbury to Williamsport; Wellsboro to New York State line; Lewisburg to Sunbury; Harrisburg to Carlisle; Carlisle to Chambersburg; Chambersburg to Maryland line; Gettysburg to Maryland line; Bedford to Hollidaysburg; Ebensburg to Hollidaysburg; Huntingdon to Hollidaysburg; Clarion to Franklin; Pittsburgh to Butler; Butler to Mercer; Mercer to Ohio line; Mercer to Meadville; Meadville to Erie; Erie to Warren; Meadville to Warren; Meadville to Franklin; Warren to Smethport; Smethport to New York State line; Ridgway to Emporium; Coudersport to Wellsboro; Washington to Waynesburg; Waynesburg to West Virginia State line (2); Uniontown to Washington; Washington to West Virginia line; Washington to Beaver; Gettysburg to York; Philadelphia to Media; Philadelphia to Maryland line; West Chester to Delaware line; York to Harrisburg; Philadelphia to Doylestown; Doylestown to Easton; Philadelphia to Delaware line; West Chester to Maryland line; Harrisburg to Lancaster; Lancaster to Maryland line; Harrisburg to Gettysburg; Wellsboro to New York line; Wellsboro to Towanda; Hollidaysburg to Clearfield; Bedford to Ebensburg; Tunkhannock to New York line; Washington to Greensburg; Washington to West Virginia line; Coudersport to New York line; Smethport to New York line; Pittsburgh to New Castle; Meadville to Franklin; Franklin to Mercer; Warren to Mercer; New Castle to Meadville; Mercer to Ohio line; Meadville to Mercer; Reading to Allentown; Allentown to Easton and Allentown to Mauch Chunk.

Harrisburg; Fourteen miles of the twenty-four miles of city streets, under contract for paving, were completed during the present year. The other ten will be paved in the Spring. The unusually mild weather of December enabled the contractors to carry on their work until the latter part of the month. There are now over sixty miles of paved streets here.

Erie; The following bids have been received by the Commissioners of Water Works in the city of Erie, Pennsylvania, for a twenty million gallon, vertical, triple expansion, pumping engine. Chester & Fleming, Union Bank building, Pittsburgh, are the consulting engineers.

Bidder.	Size	Price with No. 195 steam.	Price with No. 145 steam.	Duty with No. 145 water.	Duty with No. 125 water.	Time	Weight.
Wm. Tod Co., Youngstown, O., ...	36 & 66 & 100 x 31¾ x 66	$114,500		155,000,000	145,000,000	52 wks.	1,600,000 lbs.
	38 & 70 & 104 x 31¾ x 66						
			$114,500	153,000,000	140,000,000	52 "	1,606,000 "
Hooven, Ownes, Rentschler, Hamilton, O., ...	30 & 58 & 96 x 31½ x 60	119,950		158,000,000	156,000,000	60 "	1,550,000 "
	38 & 70 & 108 x 31½ x 60						
			124,950	152,000,000	150,000,000	60 "	1,600,000 "
Holly Mfg. Co., Buffalo, N. Y., ..	31 & 64 & 98 x 31⅞ x 66	104,769		160,000,000	160,000,000	35 "	1,520,000 "
	34 & 64 & 98 x 31⅞ x 66						
			104,769	155,000,000	155,000,000	35 "	1,520,000 "
Bethlehem Steel Co., Bethlehem, Pa., ...	35 & 66 & 98 x 31½ x 66	102,000		168,000,000	156,000,000	28 "	1,500,000 "
	35 & 68 & 104 x 31½ x 66						
			102,400	162,000,000	150,000,000	28 "	1,520,000 "
Camden Iron Works, Camden,	33 & 66 & 96 x 31¾ x 60	148,500		165,000,000	155,000,000	104 "	1,300,000 "
N. J., ...	37 & 70 & 104 x 31¾ x 60		157,000	165,000,000	155,000,000	104 "	1,310,000 "
	*33 & 66 & 96 x 31¾ x 60	150,500		160,000,000	150,000,000	104 "	1,340,000 "
	*37 & 70 & 104 x 31¾ x 60		159,000	160,000,000	150,000,000	104 "	1,400,000 "

*Reverse flow type; all others direct flow.

Duty guarantee on basis of 1,000,000 heat units consumed by engine and jackets, no allowance being made for heat returned to the boiler.

The contract has not yet been awarded.

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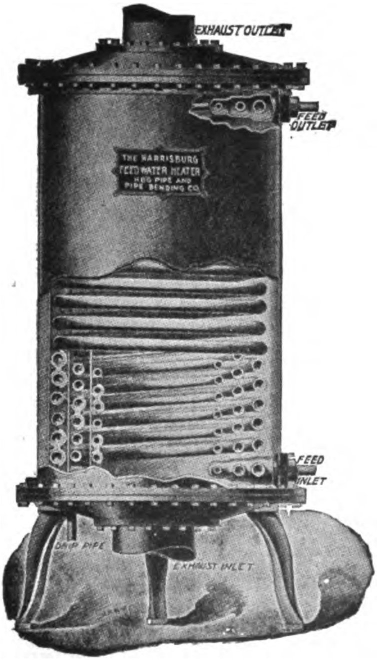
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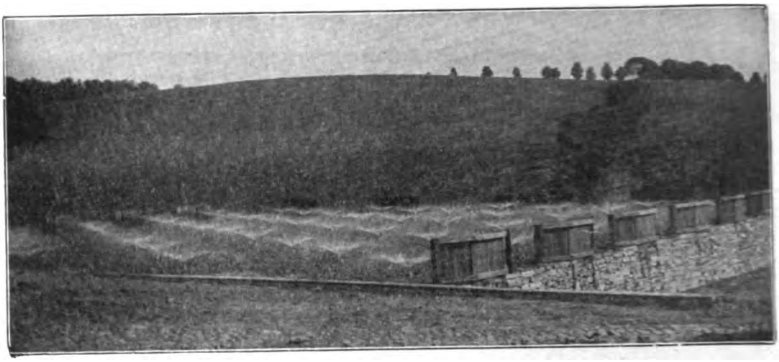

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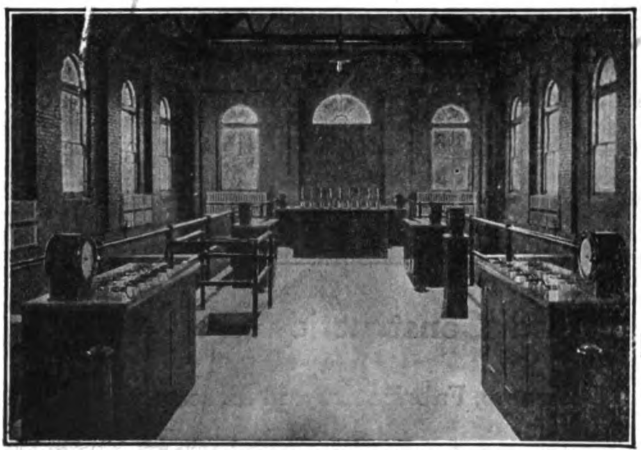

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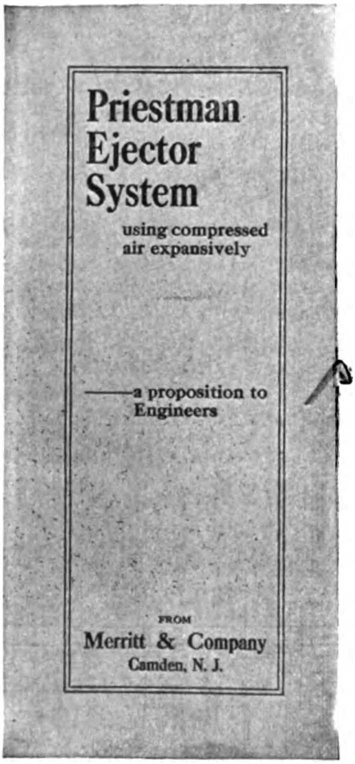

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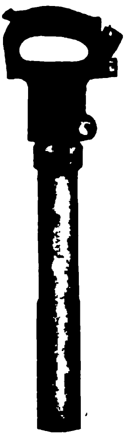

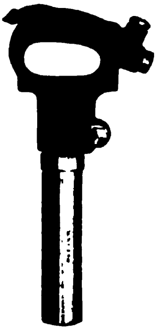

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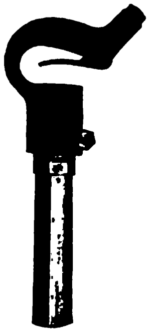

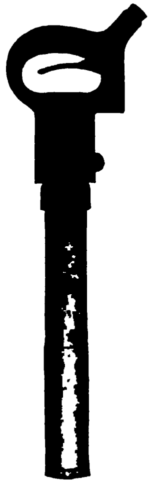

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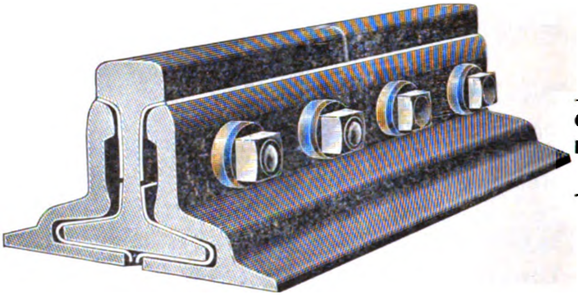

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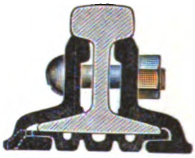

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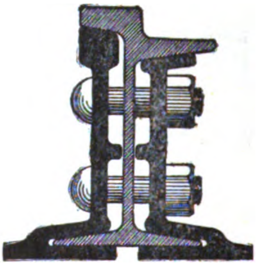

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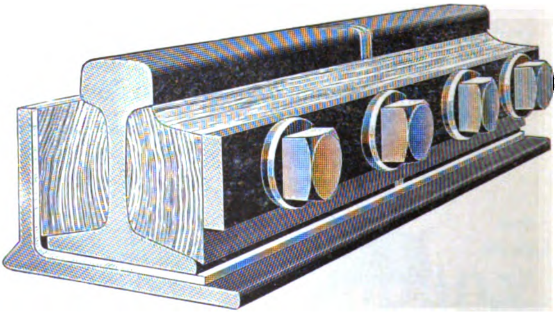

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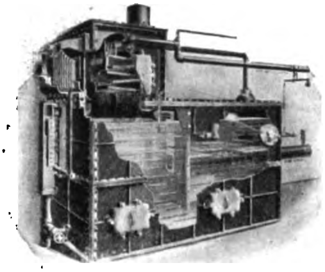

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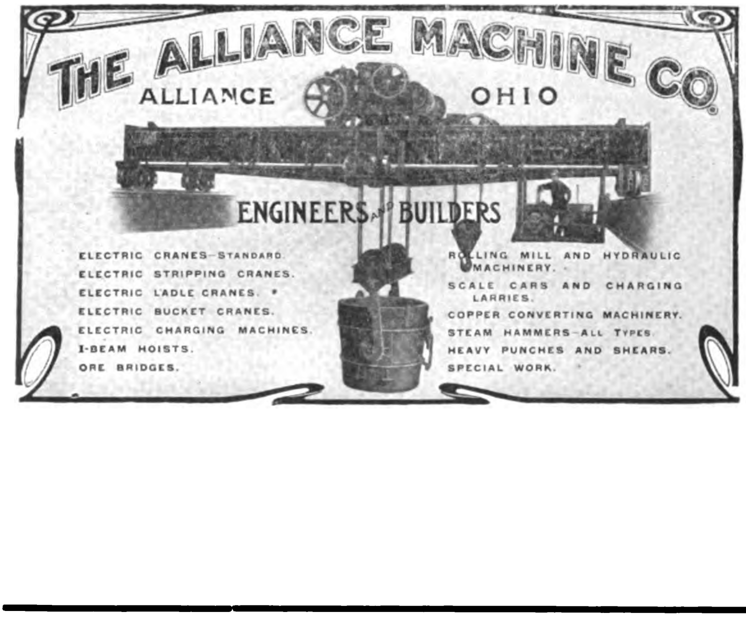

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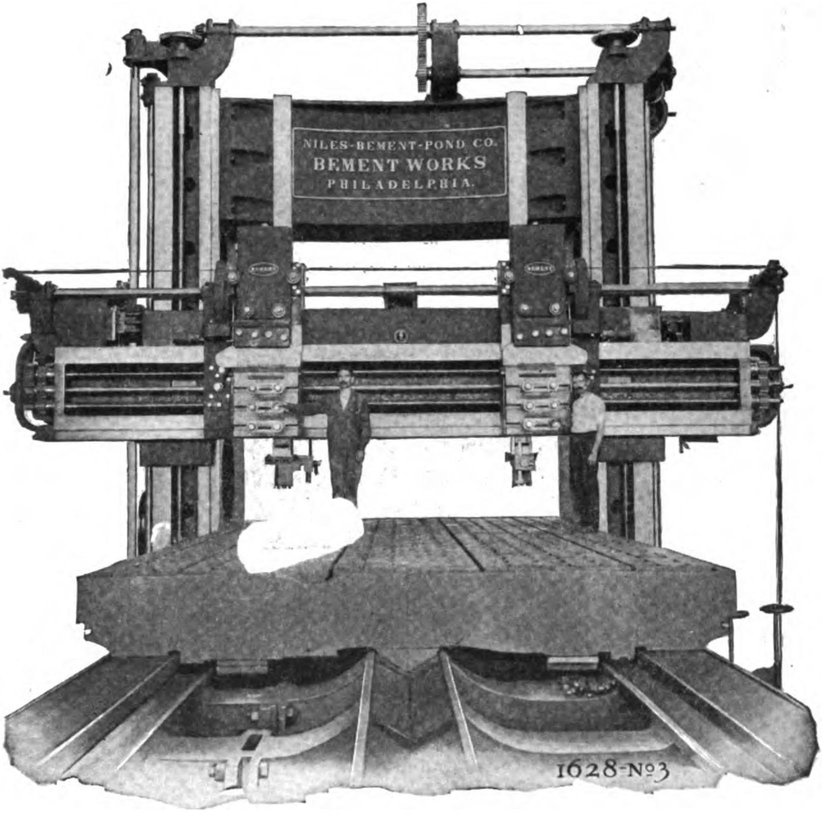

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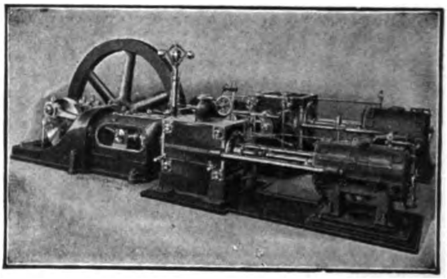

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